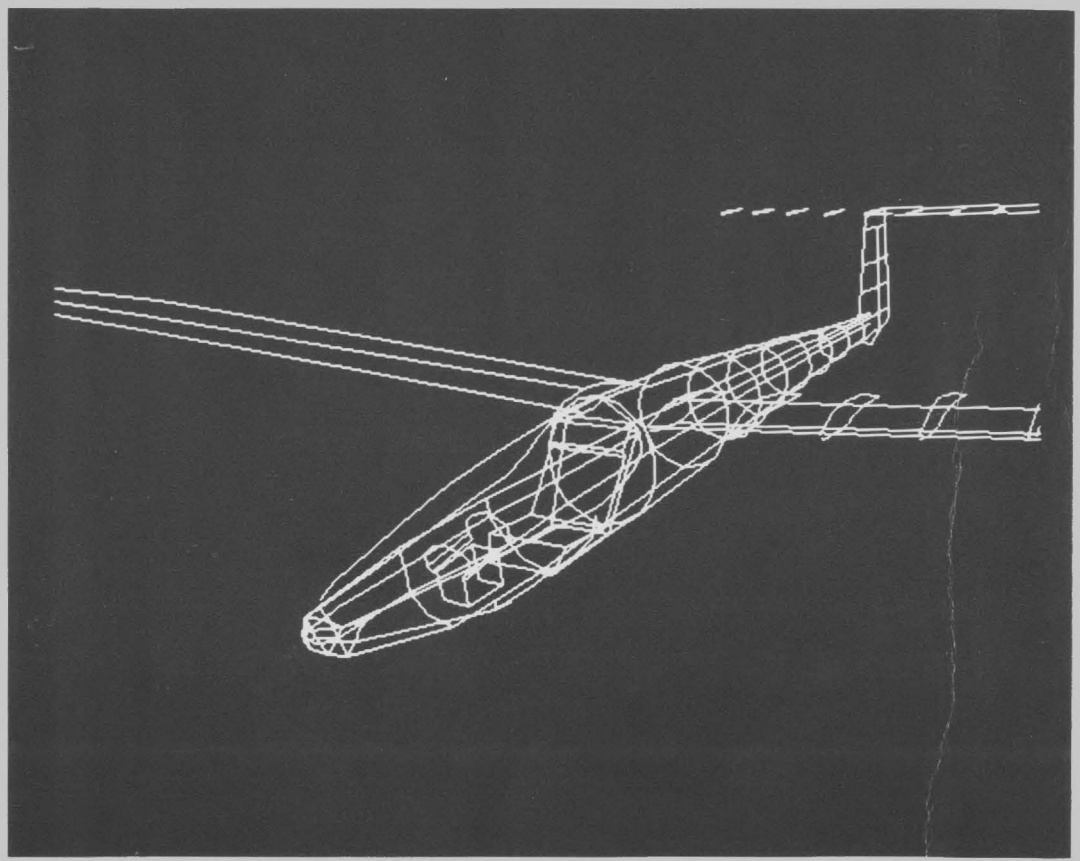
HP 2393A
Monochrome Graphic Terminal

HP 2397A
Color Graphic Terminal



HARDWARE SUPPORT MANUAL

HEWLETT PACKARD

2393A and 2397A
HARDWARE SUPPORT MANUAL

Part Number = 02393-90003
First Revision = 01 July 1985

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PREFACE

This manual provides field service information for the HP 2393A and 2397A graphics terminals. This manual is intended to be used by qualified service personnel to install, service and repair the 2393A and 2397A terminals. Because of product design, a modular repair philosophy has been implemented to minimize repair time.

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SECTION 1

PRODUCT INFORMATION

1.00 INTRODUCTION

This section provides the repair person with most of the information that is included on the 2393A data sheet and the 2397A data sheet. A product data sheet includes a list of options, accessories and specifications a customer will need to make a purchase decision. The data sheet for the 2393A and 2397A graphics terminals is the official document for product specifications. Product specifications listed in the Hardware Support Manual are not official, data sheets are revised often and reflect the most current changes.

1.10 PRODUCT DESCRIPTION

2393A GRAPHICS TERMINAL

The 2393A is a compact modular graphics terminal that is ideally suited for both business and technical display graphics. In addition, it is a very capable alphanumeric terminal for use in applications ranging from data entry to program development. It is composed of three major parts; TPU (Terminal Processing Unit), Keyboard and monochrome Monitor.

2397A COLOR GRAPHICS TERMINAL

The 2397A is a compact modular color graphics terminal that is ideally suited for both business and technical display graphics. In addition, it is a very capable full color alphanumeric terminal for use in applications ranging from data entry to program development. It is composed of three major parts; TPU (Terminal Processing Unit), Keyboard and color Monitor.

1.20 OPTIONS

2393A Graphics Terminal
2397A Color Graphics Terminal

TERMINAL OPTIONS

-049 ANSI X 3.64
-060 Delete Monitor & Video Cable

USER INSTALLABLE OPTIONS

-046 Port 2; HPIB Interface
-092 Port 2; 25 pin RS232C Interface
-093 Port 2; 8 bit parallel Centronics Interface

LOCALIZATION OPTIONS

-015 Delete US Monitor, add International Monitor
-101 Swedish
-102 Norwegian
-103 French
-104 German
-105 UK
-106 Spanish
-107 Canadian-French
-108 Canadian-English
-109 Italian
-110 Dutch
-111 Finnish
-112 Danish
-113 Swiss-German
-114 Swiss-French
-115 Spanish-Latin America
-116 Flemish

CABLE OPTIONS

-301 40242M - US Modem
-302 40242M - European Modem
-303 40242C - RS232C
-304 40242X - RS232C Direct Connect
-305 40242Y - EMP Protect
-306 40242P - RS422 Direct Connect

1.30 ACCESSORIES

PORT 2 INTERFACE ACCESSORIES

-40210R	Port 2; 25 pin RS232 Interface
-40210P	Port 2; 8 Bit Parallel Centronic Interface
-40210H	Port 2; HPIB Interface

CABLE ACCESSORIES

-40242A	Converter Cable M25/F50, 1m (3.3ft)
-40242C	RS232C Cable F25/M25, 5m (16ft)
-40242M	US/European Modem Cable M25/M25, 5m (16ft)
-40242P	HP Direct Connect 422 Cable M25/M5, 5m (16ft)
-40242X	HP Direct Connect 232 Cable M25/M3, 5m (16ft)
-40242Y	EMP Protect Cable M25/M25, 5m (16ft)
-40242Z	RS232C Modem Bypass Cable M25/F25, 5m (16ft)
-40242D	Parallel Printer Cable M36/M36, 2m (6.6ft)
-40242G	Serial Printer Cable M25/M25, 5m (16ft)
-45529A	HPIB Printer/Plotter Cable, 1m (3.3ft.)
-40242V	Monochrome Video Cable, 0.4m (1.5ft.)
-40242R	Color Video Cable, 0.4m (1.5ft.)

1.40 SPECIFICATIONS

1.41 PHYSICAL SPECIFICATIONS

TPU Weight: 4.3 kg. or (9.5 lb.)

TPU Dimensions: H 100 mm x W 325 mm x D 325 mm
H 3.9 in x W 12.8 in x D 12.8 in

Keyboard Weight: 2.14 kg or (4.7 lb)

Keyboard Dimensions:

Flat
35mm(H) x 456mm(W) x 225mm(D)
1.4in(H) x 18in (w) x 8.9in(D)
Standing
63mm(H) x 456mm(W) x 225mm(D)
2.5in(H) x 18in (W) x 8.9in(D)

1.42 ELECTRICAL SPECIFICATIONS

OPERATING VOLTAGE and FREQUENCY REQUIREMENTS :
TPU Input Voltage: 90 VAC to 132 VAC or 180 Vac to 264 Vac
TPU Input Frequency: 47 Hz to 66 Hz

POWER CONSUMPTION:
Terminal Processing Unit = 50 watts.

POWER DISSIPATION:
Terminal Processing Unit = 170 BTU mean.

MAXIMUM STEADY STATE CURRENT:
Terminal Processing Unit @ 110 volts = 1 amp.
Terminal Processing Unit @ 220 volts = 1/2 amp.

1.43 MECHANICAL SPECIFICATIONS

KEYBOARDS

Style: Detachable typewriter keyboard with 2.4 meter (8 ft.) fully extended length coiled cable.

Layout: 107 sculptured keys. Separate numeric keypad and independent user, editing and cursor keys. 17 national layouts are available: USASCII, Swedish, Norwegian, French, German, UK, Spanish, French-Canadian, English-Canadian, Italian, Dutch, Finnish, Danish, Swiss-German, Swiss-French, Spanish-Latin American and Flemish.

Operation: Auto repeat; N-key rollover.

Function Keys: 8 screen labeled user-defined function keys; screen labels up to 16 characters and function key definitions up to 80 characters in length. Can include control codes and escape sequences. 4 additional user-definable auto-executable function keys; definitions can be saved in non-volatile memory. An additional 8 predefined function keys are available.

Included Overlays: An overlay is included for the numeric pad which labels the graphics functions active when the graphics pad is enabled.
An ANSI overlay is also included for numeric pad when ANSI or EM52 modes are enabled.

ERGONOMICS

The 2393A and 2397A terminals offer modular design with standard ergonomic features. These features include an integral tilt and swivel mechanism, front panel power, brightness and contrast controls, and an anti-glare display screen. In addition, the low profile detachable keyboard can be adjusted for use in either a flat or angled position. The sculptered keys are color-coded and conveniently clustered by function.

For quiet operation, the 2393A and 2397A terminals are convection cooled, eliminating the need for a noisy fan.

1.44 ENVIRONMENTAL SPECIFICATIONS

TEMPERATURE, Free Space Ambient:
Non-Operating: -40 to + 75C (-40 to +167F)
Operating: 0 to +55C (+32 to +131 F)

HUMIDITY:
Non-Operating: 90% Relative Humidity at 65C
Operating: 5 to 95% Relative Humidity at 40C

ALTITUDE:
Non-Operating: Sea level to 15,300 meters (50,000 Ft.)
Operating: Sea level to 4572 meters (15,000 Ft.)

VIBRATION and SHOCK:
Type tested to qualify for normal shipping and handling in original shipping container.

1.45 SAFETY SPECIFICATIONS

PRODUCT REGULATIONS / SAFETY

UNITED STATES :
UL 478 Information Processing Equipment.
UL 114 Office Appliances.

CANADA : CSA C22.2 No. 154 Data Processing Equipment.
GERMANY : TUV approval pending
FINLAND : FEI approval pending.

INTERNATIONAL :
IEC 380 Safety of Electrical Energized Office Machines.
IEC 435 Safety of Data Processing Equipment.

RADIO FREQUENCY INTERFERENCE :
United States = FCC Docket 20780 part 15 for Class A Equipment
Germany = VDE 0871 Level B

1.46 STANDARDS

DATACOMM:
Australia - Telecom: Approved
Belgium - PTT: Application submitted, approval pending.
Germany - FTZ: Approved
Japan: Approved
Sweden - PTT: Application submitted, approval pending.
United Kingdom - BT: Application submitted, approval pending.
Nordic Network: Application submitted, approval pending.
(Finland, Norway and Denmark)

Contact local HP Sales Office for current status of datacomm approval in your country.

1.47 GRAPHICS

Addressability: 32k x 32k points in HP mode.
4096 x 4096 points in TEK 4014 mode.
1024 x 1024 points in TEK 4010 mode.

Viewable Resolution: 512(h) x 390(v) pixels or
640(h) x 400(v) pixels, Selectable

Display Area: 160 mm x 214 mm (6.3 inches x 8.4 inches)

Cursor: Crosshair

Primatives: Polyline; 11 line types.
Area fill; fill polygons up to 105 sides using 10 patterns + dither patterns for color.
Text; 8 sizes, normal or slant, 4 orientations, 10 fully supported national character sets.

Compatibility: The 2393A and 2397A terminals have a TEKTRONIX 4010 / 4014 compatibility mode that allows images designed for those terminals to be displayed in scaled or unscaled modes.

COLOR GRAPHICS

The 8 predefined colors are red, green, blue, cyan, magenta, yellow, black and white. The user can select 8 out of a possible 64 colors at time. Dithering can be used to extend the range of color possibilities.

GRAPHICS SOFTWARE SUPPORT

The 2393A and 2397A terminals are supported by a wide variety of Hewlett-Packard software.

Graphics 1000/II and Graphics 9000 are high level graphics application development tools designed for use on HP1000 and HP 9000 computer systems respectively and can provide a solution to a range of technical display graphics applications.

DSG/3000, HPDRAW, HPEASYCHART, and HPMAP are designed specifically for business applications on the HP3000 computer systems.

The TEKTRONIX 4010/4014 compatibility mode allows the 2393A or 2397A to operate with TEKTRONIX Inc's PLOT 10 software.

In addition to Hewlett-Packard software, the 2393A operates with Percision Visual's DI-3000 and GRAFMAKER or ISSCO's DISSPLA and TEL-A-GRAF or SAS Institute's SAS/GRAPH and Megatek's TEMPLATE These packages run on HP as well as non-HP systems.

1.48 ALPHANUMERICS

Display Area: 155 mm x 201 mm (6.1 inches x 7.9 inches) or
124 mm x 201 mm (4.9 inches x 7.9 inches)
Selectable.

Character Generation: 7 x 11 dot matrix in a 8 x 14 dot
character cell with half-dot shift.

Character Size: 1.9 mm x 3.7 mm (0.075 inches x 0.146 inches)

Screen Capacity: 24 lines x 80 columns (1920 characters).
25th and 26th lines for function key labels.
27th line for terminal status information.

Character Set: ROMAN 8 comprising 128 ASCII character set and
61 national characters from the extended Roman
set. National characters include UK, Danish,
Finnish, French, German, Italian, Norwegian,
Spanish, and Swedish. Plus Line Drawing, Math,
Italics, and Bold characters.
Total of 768 characters.

Cursor: Blinking underline or blinking block.

Display Enhancements: Inverse, underline, blinking, halfbright, and double high double wide in any combination.
Security video is available on the 2393A graphics terminal only.

Video Attributes: Memory lock, display lock, protected fields, user selectable margins, and tabs, plus jump or smooth scrolling.

Editing: Insert character, insert line, delete character, delete line, clear line, clear all. Insert and delete character with wrap around.

Page Control: Next and previous page controls as well as top, bottom, left and right.

Display Memory: Memory is allocated dynamically. Up to 12 pages standard (288 lines x 80 columns or 144 lines x 160 columns). Depending on the number of display enhancements used the memory available can vary.

ANSI X3.64
Compatibility: The 2393A and 2397A provides a subset of the ANSI X3.64 standard for those users requiring a device-independent environment. In addition, the 2393A and 2397A can execute many DEC. VT100 and VT52 control sequences. The user can select this mode via the terminal's configuration menu or programmatically from the host system. While in ANSI character mode operation, the user has access to TEKTRONIX compatibility mode in order to run PLOT 10 software.

COLOR ALPHANUMERICS

8 foreground / background color pairs selected from a possible 64 combinations. Predefined colors are red, green, blue, yellow, cyan, magenta, black, and white.

1.49 DATA COMMUNICATIONS SPECIFICATIONS

INPUT DEVICE SUPPORT

With the unique HP-HIL (Human Interface Link) on the 2393A and 2397A terminals, the user can connect several input and output devices simultaneously. These terminals allow the user to chain up to three input devices to the keyboard, thus offering considerable flexibility in the input configuration and freeing the auxiliary port for hardcopy devices. Supported graphics input devices include HP Touch, Mouse, Graphics Tablet and Bar Code reader. These accessories may be ordered separately.

The touchscreen can be used in alphanumeric as well as graphics applications. To facilitate data entry and speed data inquiry in alphanumeric mode, the touchscreen can be used to select softkeys, user-defined fields or to move the cursor to a desired location. In graphics mode, the touchscreen duplicates the functions of a mouse. For example, you can use your finger to draw a line.

The mouse can be used in graphics operations to move, draw and pick objects. As a positioning device, it is faster than graphics cursor keys on the keyboard, and hence an aid to productivity.

The graphics tablet is ideal for digitizing and sketching drawings. It is useful in interactive graphics, graphics entry and menu selection applications.

The barcode reader is well suited for rapid data entry applications, e.g. inventory tracking, document tracking, product identification, etc.

OUTPUT DEVICE SUPPORT

The 2393A and the 2397A terminals offers a broad range of output options. This allows the user flexibility in connecting to a host of HP peripherals.

The user can generate engineering drawings, charts and overhead transparencies on HP plotters, print text and graphics on Thinkjet and other HP printers, and create 35mm slides on a HP film recorder.

In addition, the 2393A and 2397A terminals can be connected to commercial large screen projectors, film recorders or large monitors.

DATA COMMUNICATIONS

GENERAL
The 2393A and 2397A terminals have two data comm ports. Port 1 is standard and Port 2 is optional. On optional Port 2, there is a choice of accessory I/O modules to choose from. Only one of the two ports can be used to communicate with a CPU at any given time. The second port will normally be used to communicate with a peripheral such as a printer.

DATA RATE
110, 134.5, 150, 300, 600, 1200, 1800, 2400, 4800, 9600 and 19,200.

THROUGHPUT
Throughput is the speed that the terminal can accept data without handshaking. Throughput is dependent upon several factors. One factor the type of data that is being sent to the terminal. The quickest data for the terminal to process is vanilla characters, which are alphanumeric characters without control codes, graphic vectors or ESC sequences. When plain vanilla characters are being sent to the terminal, the throughput can be 9600 baud. Any type of esc secquences, control codes or graphic vectors can decrease the throughput rate.

Another limiting factor for terminal throughput is when the terminal is hooked to a printer or plotter. If the CPU is dumping data to a peripheral through the terminal, ie. log top mode, the throughput of the peripheral will limit the rate the terminal can accept data.

Simple graphic data throughput is 2400 baud, ie. vector drawing speed. Graphic functions such as polygonal area fill will lower the throughput speed.

The 2393A and 2397A can operate at 19,200 baud rate if handshaking is used and the cable length specifications are followed.

HANDSHAKING
System port: Selectable HP-ENQ/ACK, XON/XOFF and HARDWARE SIGNALS; CS (Clear to Send), TR (Terminal Ready), DM (Data Set Ready) and RR (Receiver Ready).

Optional Peripheral Port: Selectable XON/XOFF (transmit only) or HARDWARE SIGNALS CS (Clear to Send), TR (Terminal Ready) and DM (Data Set Ready).

These protocols are designed to protect data integrity, and at least one should always be used. If handshaking is not used the user is risking data over-flow problems.

PARITY
Selectable in 7 bit operation; odd, even, zero and one.
8 bit operation is always none.

OPERATING MODES
Local, remote, character, block line, block page, and format.
X.25 compatible using XON/XOFF when block mode is enabled and when the terminal is connected to an external PAD.

TRANSMISSION MODES
Full duplex, asynchronous point to point. Compatible with Bell 103A, Bell 212A, Vadic VA3400 or equivalent full duplex modem.

PORT 1
This port is standard and is part of the processor PCA. It is a 25 pin RS-232C port with HP-422 direct connect capabilities depending on the cable used.

PORT 2
This port is optional and is not included on a standard terminal. The user will have several options to choose from. These options are listed below;

PORT 2, RS232C Auxiliary Module
This is a 25 pin RS-232C port.

PORT 2, HPIB Auxiliary Module
The HPIB interface is 8 bit parallel. The data rate is fixed. Handshaking is also fixed and is dependent upon hardware lines.

PORT 2, CENTRONICS PARALLEL Auxiliary Module
This is another 8 bit parallel interface. The data rate is also fixed. Handshaking is done using hardware lines.

1.50 SERIAL NUMBER INFORMATION

Each terminal is marked with a serial number. It is a unique number for each terminal produced. This serial number is located on the back panel of the TPU. It should be referred to when reporting warranty repairs, inventory tracking or unit identification. The prefix to the serial number indicates the date of the last significant revision. The letter in the middle of the serial number identifies the manufacturing site.

Example; 2551 A 12673 = Serial Number

For this example the unit number is 12,673.

The manufacturing site is A.

The date code is the fifty first week of 1985.
The first two numbers indicate the year by adding 60 to that number. The second two numbers indicate the week.

1.60 SUPPORTED EQUIPMENT

MONITORS

35721A/B	14" Monochrome Monitor
35731A/B	12" Monochrome Monitor
35741A/B	12" Color Monitor
13279B	19" Color Monitor

ALPHANUMERIC PRINTERS

2671A	Thermal Printer
2601A	Daisy Wheel Printer
2602A	Daisy Wheel Printer
82905	Impact Printer
2932A	Impact Printer
2934A	Impact Printer

GRAPHIC PRINTERS

2671G	Thermal Graphics Printer
2673A	Intelligent Thermal Graphic Printer
2932A	Impact Graphics Printer
2934A	Impact Graphics Printer
2225A/C/D	Thinkjet
2686A	Laserjet
82906A	Impact Graphics Printer
C150	Diablo Color Inkjet Printer

FILM RECORDER

7510A	Film Recorder/HP-IB

PLOTTERS

7585B	E Size Drafting Plotter
7580B	D Size Drafting Plotter
7586B	Plotter
7470A	2 Pen Plotter
7475A	6 Pen Plotter
7550A	8 Pen Plotter

MODEMS

103A Bell	300 Baud Full Duplex
212A Bell	1200 Baud Full Duplex

SUPPORTED HP-HIL INPUT DEVICES

46060A	Mouse
46020A	Keyboard
92916A	Barcode Reader
46087A	A-Size Digitizer
46088A	B-Size Digitizer
35723A	Touchscreen

TERMINAL COMPATIBILITIES

HP 2623A
HP 2627A for the 2397A
HP 150
TEK 4010
TEK 4014
VT 52
VT 100
ANSI X3.64

1.70 SUGGESTED TEST EQUIPMENT

A voltmeter can be used to monitor power supply voltages on the test module. For communication problems an RS-232 line analyzer can be used to monitor the data transmission between the terminal and the computer.

1.80 WARRANTY

Warranty conforms to the terms and conditions outlined in the current Computer Systems Group Contract regarding terminals. It is return to HP and covers parts and labor.

1.90 SUPPORT STRATEGY

The prime repair method for terminals is module replacement. Each terminal is equipped with several internal self-test features to localize a problem to a faulty module. Refer to Section 8 Troubleshooting and Diagnostics of this manual for detailed repair information.

SECTION 2

SITE PLANNING and REQUIREMENTS

2.00 INTRODUCTION

The customer is responsible for installation of this product and is also responsible for site preparation and planning. However the Customer Engineer should have a good knowledge of site preparation in case the customer needs advice or assistance. The repair person should also be aware of site requirements in case an environmental extreme is the source of a terminal failure.

2.10 ELECTRICAL REQUIREMENTS

For terminal installation, two AC wall receptacles are required. The wall receptacles must include an isolated ground connection. Proper grounding is vitally important for safe and reliable operation of electrical equipment. The monitor and TPU each have a power cord. If a printer or plotter is also to be installed, three wall receptacles are required.

OPERATING VOLTAGE and FREQUENCY REQUIREMENTS :

TPU Input Voltage: 90 VAC to 132 VAC or 180 Vac to 264 Vac

TPU Input Frequency: 47 Hz to 66 Hz

POWER CONSUMPTION:
Terminal Processing Unit 50 watts

POWER DISSIPATION:
Terminal Processing Unit 170 BTU/h mean

MAXIMUM STEADY STATE CURRENT
Terminal Processing Unit @ 110 volts = 1 amp
Terminal Processing Unit @ 220 volts = 1/2 amp

2.20 ENVIRONMENTAL REQUIREMENTS

The temperature and humidity specifications listed below are the minimum and maximum values. Minimum and maximum values are provided as a temporary safety margin. This allows time to correct the environmental extreme and still have the terminal operate reliably.

There is an optimum range for temperature and humidity. If the equipment is operated in this range it will increase the reliability of the terminal. For example, high temperatures will increase the rate of decay of most components comprised in a terminal. The optimum range for temperature is 20 to 30 degrees centigrade or 68 to 86 degrees fahrenheit. The optimum range for humidity is 40% to 60% with no condensation.

Vibration can cause slow degradation of mechanical connectors and component parts. The best preventive measure is to locate the terminal away from vibration.

TEMPERATURE, Free Space Ambient:
Non-Operating: -40 to + 75C (-40 to +167F)
Operating: 0 to +55C (+32 to +131 F)

HUMIDITY:
Non-Operating: 90% Relative Humidity at 65C
Operating: 5 to 95% Relative Humidity at 40C

ALTITUDE:
Non-Operating: Sea level to 15300 meters (50,000 Ft.)
Operating: Sea level to 4572 meters (15,000 Ft.)

VIBRATION and SHOCK:
Type tested to qualify for normal shipping and handling in original shipping container.

2.30 STATIC

One of the more difficult problems to deal with is electrostatic discharge or ESD. Static charges buildup on non-conductive surfaces, as contact between the two surfaces is broken. These static charges can easily build to 20 thousand volts. If a static charge is discharged into a terminal, it can cause temporary interruption of terminal operation or, in extreme cases, a failure.

Static charges are generated more easily when the air is dry. The lower the humidity the easier it is to generate ESD. High static charges can build up on the bodies and clothing of people walking around a room, especially a carpeted one. Static also builds up on paper, especially paper that comes in contact with a movable print head.

If static is a problem there are some ways to control it. ESD control involves providing a conductive path to ground. There are several ways to do this. They include conductive mats, antistatic sprays, humidifiers and tinsel strips on printers. Proper terminal grounding is critical in preventing static problems. Incorrectly wired wall sockets and improper grounding can particularly aggravate static problems since there is no path to discharge elestrostatic charges. The TPU has a metal case that is connected to ground to protect it from ESD. If a person carrying a charge touches the TPU, the metal case acts as a conductive path to ground protecting the electronic circuits inside the metal box.

2.40 PLANNING EQUIPMENT LOCATION

There are several points to consider when installing a terminal. {Normally a terminal is placed on a user's desk and this is usually a good installation.} First of all the terminal should be placed on a flat, level surface, since the monitor is placed on top of the TPU box.

Second, there should be adequate ventilation around the terminal to prevent it from overheating. The TPU is convection cooled with the air input in the front and the air output in the rear. Since there is no fan, it is important the airflow vents are not obstructed. Avoid putting the TPU flush against a wall. Leave aproximately 6 inches to a foot clearance between the wall and the TPU. Also, avoid places which enclose the terminal on several sides and severely restrict the airflow.

Third, the terminal should be located away from adverse climates. Avoid placing a terminal near doors that are left open to the outside which could expose the terminal to extreme temperatures and temperature fluctuations. Sunlight from a southern window striking a terminal can cause glare on the display and increase the operating temperature of the unit.

2.50 RADIO FREQUENCY INTERFERENCE (RFI)

This equipment generates, uses and can radiate radio frequency energy. If not installed and used in accordance with the manufacturer's instruction manuals, it may cause interference to radio and television reception. It has been tested and found to comply with the limits of a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever steps may be required to correct the produced interference.

To minimize the potential for radio and TV interference, use the manufacturer's recommended, certified peripherals and shielded interface cables. Original system certification tests were conducted with certified peripherals and shielded cables. If, in a particular installation, this equipment does interfere with radio and TV reception, relocating, or moving the TPU away from the reciever, reorienting the receiving antenna, and plugging the TPU into a different branch circuit outlet may help.

Radio interference can cause a variety of problems with electronic equipment. Therefore, avoid installing a TPU in areas where possible radio interference may occur. Some of the most common sources of radio interference are airports (which have communications and radar installations), business two-way radio transmitters, or broadcast radio/TV transmitters. Hand held transceivers (i.e., "walkie-talkies") produce the same effect as a radio station when used near electronic equipment and should therefore be prohibited from the areas in which electronic equipment is installed. Additionally, a microwave link aimed from adjacent buildings could present trouble for electronic equipment installed in its transmission path.

SECTION 3

INSTALLATION and CONFIGURATION

3.00 INTRODUCTION

In most cases the terminal will be installed by the customer, and installation is his/her responsibility. When installing a terminal, the procedure is the same for the customer as it is for the Customer Engineer. This terminal is designed to work in a typical office environment. Specific environmental specifications can be found in section two.

3.10 UNPACKING and INSPECTION

Each terminal will consist of at least two packages. The contents of the two main packages will be the Keyboard and TPU in one package and the Monitor in the other. Check the original order with the shipping invoice to be sure that both lists match. Then check the packages with the shipping invoice to be sure the shipment is intact.

Inspect the packages for shipping damage. This could be water marks; crushed, dented or cut boxes. If there is evidence of excessive shipping damage, write on the bill of lading "Apparent Damage-subject to inspection". Then arrange for both the carrier's representive and the local Customer Engineer to be present when the package is opened. The carrier is responsible for shipping damage. Shipping damage is not covered under warranty.

Unpack each carton separately and check the carton contents against the packing list and original order form. While unpacking each box, keep its contents, (manuals, cables and cords) together. Be sure that all pieces are removed from the packing materials. Some pieces may be difficult to find inside a box, so a thorough search is usually rewarded.

The customer should keep and store the empty cartons and packing materials in case it is necessary to return a component for repair or warranty.

3.20 REPACKING

Repacking is necessary when a terminal component has failed and it is necessary to send it to an FRC for repair. Most warranty repairs on terminal products are returned to Hewlett-Packard. If a warranty repair is done at a customer site the customer is responsible for travel charges, to and from his/her site. Also FRC service contracts are very affordable but the customer must return the broken component to the FRC for repair.

3.30 LINE VOLTAGE and FUSING

After unpacking the monitor and terminal modules, they should be checked for the proper voltage settings. The setting can be checked by reading the back panel labels and by checking the physical position of the switches located on the back panels of the TPU and monitor. These settings should agree with the line voltage of wall receptacles the terminal will be plugged into. If the TPU or Monitor is set for 115V operation and is plugged into a 230V wall receptacle there is a high probability that a fuse will be blown, and damage may occur.
The fuse is not changeable for the TPU. It is the same for both 115 volt and 230 volt applications. The fuse is part of the Power Supply PCA and is soldered into that module. If the fuse is blown in the TPU module, the Power Supply PCA must be replaced.

3.40 INSTALLATION INSTRUCTIONS

After the keyboard, monitor and terminal modules have been unpacked and power settings checked, it is time to assemble the terminal. Choose a clean, flat surface on which to position the terminal. (It should be positioned away from direct sunlight to minimize glare on the display.) The desk or table on which it is to be placed should have a hard flat level surface so that ventilation is not obstructed and the modules can be stacked. The terminal should be positioned within 6 feet of a power receptacle with a good ground. The terminal module (TPU) is placed into position first. The front of the terminal module is the side with the power switch, and is placed toward the operator. The back of the unit is the side with the cable connectors and labels.

Place the on/off switch in the off position. Find the power cord for the TPU and plug it into the receptacle in the back of the TPU and the other end into the wall receptacle.

CAUTION

Be sure when plugging the power cord into the wall receptacle that it is a three hole receptacle. The third hole is for ground and the terminal depends on this ground for ESD and RFI purposes. Without a good ground the terminal may not perform to specifications.

Now place the monitor on top of the TPU with the display facing the operator. Place the on/off switch in the off position on the monitor. Locate the power cord for the Monitor and plug it into the receptacle in the back of the Monitor and the other end into the wall receptacle.

The next step is to connect the video cable between the Monitor and TPU. For the 2393A, locate the video cable and plug the phono-type connector onto the back of the Monitor. The BNC connector attaches to the rear panel of the TPU. Be sure to plug the video cable into the correct receptacle on the back of the monitor. There are two receptacles that are similar. The one marked with a music note is for a speaker input.

For the 2397A, locate the video cable which is a combination of three BNC to BNC cables. Connect the three BNC connectors to the rear panel of the TPU marked; R, G, B. Then connect the other end of the cable to the BNC receptacles on the rear panel of the Monitor marked R, G, B. Be sure to connect both ends of a cable to like receptacles. For example, R to R, G to G and B to B. Actually R is red, G is green and B is blue. These are the color signals.

Now locate the HP-HIL cable. Please note that this cable has two dots marked on one end and one dot marked on the other end. The connector on each end of this cable is keyed differently and must be plugged into a like receptacle on the back of an input device. That is, match a one dot connector with a one dot receptacle and a two dot connector with a two dot receptacle.

This cable is used to connect HP-HIL input devices to the TPU. The first HP-HIL input device to hook up is the keyboard. Connect the end of the cable with two dots to the HP-HIL receptacle on the rear panel of the TPU with two dots. Now connect the other end of the cable with one dot to the receptacle on the back of the keyboard with one dot. The cable can be placed under the cable run on the keyboard. The keyboard is now installed.

If there is more than one HP-HIL device the others can be chained together using an HP-HIL cable for each device. The next device would be plugged into the rear of the keyboard.

If a touchscreen is included with the terminal it is installed as the first device and then the keyboard plugs into the touchscreen. Actually the receptacles for the touchscreen are located on the rear panel of the monitor and the touchscreen is plugged into the front of the monitor when it is installed.

3.50 SELF-TESTS

Now that the TPU, Keyboard and Monitor have been connected together and to power, it is time to apply power and run some self-tests. Applying power initiates an OFF/ON Test.

If the OFF/ON Test is successful then a blinking cursor is displayed in the upper left hand corner and the soft key labels are displayed at the bottom of the screen. The next step would be to run a Terminal Test. A self-test pattern should appear on the display after successful completion of the Terminal Test. At this time the Monitor's display can be adjusted, (for details see the respective Monitor's service manual.)

At this time a Datacomm test can also be executed to check port 1.

If the OFF/ON Test, Terminal Test or Datacomm Test is unsuccessful then the installation procedure should be rechecked. If the second attempt is unsuccessful then refer to Section 8 Troubleshooting and Diagnostics. Section 8 also contains details for each self-test.

3.60 INTERCONNECTIONS

Cables for terminals are described in the "Cabling Manual", HP part number 5957-9918. This manual describes the wiring diagram for each cable.

Cables can be ordered through the "Computer Users Catalog" which is supported by DMK (Direct Marketing Division).

3.70 SWITCH SETTINGS

There is only one selectable switch on the TPU and it is located on the back panel. It switches between 115 and 230 volts AC.

3.80 USER INFORMATION

User information is contained in two manuals that are included with each terminal. They are the Users Manual, (02393-90001) and the Reference Manual, (02393-90002).

3.90 INSTALLING ACCESSORIES

If a port 2 datacomm accessory was ordered with the TPU or as an accessory it must be installed by the customer. Below is a list of accessories available for port 2.

40210R Port 2; 25 pin RS-232 Interface
40210P Port 2; 8 Bit Parallel Interface
40210H Port 2; HPIB Interface

To install a port 2 datacomm accessory follow the instructions below. See figure 12-466 I/O PCA Removal / Replacement for an illustration of this process.

**** Tools Required**

1. Table Top Static Mat
2. #2 Pozidriv (Screwdriver)

**** Installation Procedure**

1. Turn the power off at the TPU.

2. Remove the cover plate from port 2 on the back panel of TPU. It is secured with two screws and they should be removed along with the cover plate.

3. Position the port 2 accessory into the port 2 slot and push into place. Screw the two retainers into the back panel of the TPU.

4. Turn on the TPU power.

5. If the accessory 40210R or 40210H has been installed a Datacomm Test can be run to verify proper operation. See paragraph 8.54 Data Comm Test for more details.

3.91 UPGRADE INSTRUCTIONS

The TPU has been designed with a ROM module that is removable from the back panel. It can be removed or installed as easily as the port 2 I/O module. The TPU was designed to allow field upgrades by customers if a field upgrade becomes available. Below is a list of instructions to replace the ROM module. See figure 12-465 ROM Removal / Replacement for an illustration of this procedure.

**** Tools Required**

1. #2 pozidriv (Screwdriver)
2. Table top static mat

**** Removal Procedure**

1. Turn the power off on the TPU and unplug the line cord.

2. Remove the plate that covers the ROM PCA module; it is secured by two screws.

3. The ROM module cover has a hole in one end. It is used as a tool to remove the ROM module. There is a post on the ROM PCA that the hole in the ROM cover plate is placed over. The ROM PCA module is then pulled out using the ROM module cover plate.

**** Replacement Procedure**

1. The new ROM module slides into the ROM module slot. Be sure that the module is fully seated in the slot.

2. Replace the ROM module cover plate and fasten it to the back panel with two screws.

3. Turn on power to the TPU.

4. Execute IDENTIFY HARDWARE in the service keys. This will identify the ROM PCA that has been installed. At this time a check can be made to verify that the proper ROM module has been installed by checking part numbers and revision levels. See paragraph 8.55 Identify Hardware for more details.

3.92 CONFIGURATION

Configuration menu information is contained in two manuals that are included with each terminal. They are the Users Manual, (02393-90001) and the Reference Manual, (02393-90002).

3.93 HP COMPUTER CONNECTIONS

Figures 3-921, 3-922 and Tables 3-924, 3-925, 3-926 and 3-927 are intended to provide information related to configuring the terminals for connection to HP systems. They cover connections to HP1000 and HP3000 computer systems.

The terminal/system connections mentioned are not necessarily the only ones which work. Many parameters, such as baud rates or parity settings are supported on HP systems for many different settings. The particular operating characteristics for each application should always be given primary attention.

All the connections mentioned below apply to the physical hardware connection between the HP 2393A and 2397A graphics terminals and the referenced HP computers. These connections do not imply support of the HP 2393A and 2397A graphics terminals on the various software available on these HP computers. For this information, refer to the particular computer's operating system documentation, configuration guides or consult the computer's software technical support teams for verfication of the software supporting the HP 2393A and 2397A.

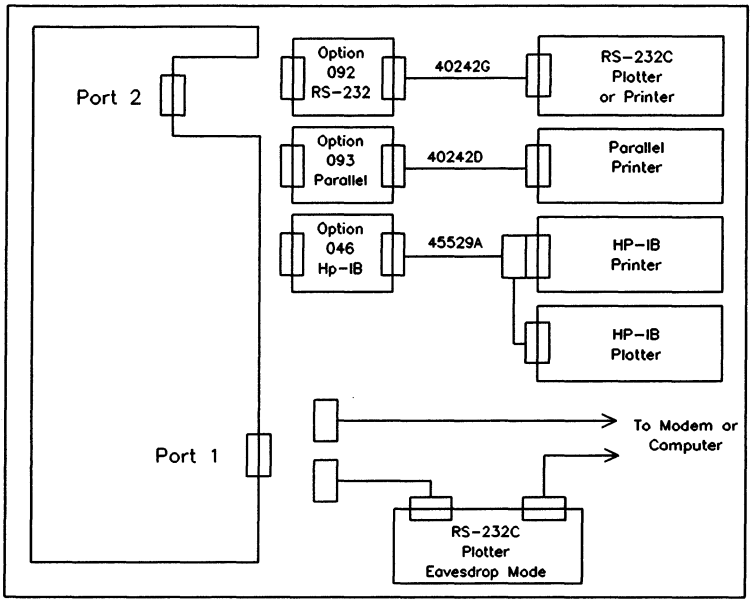

Figure 3-921 TPU Connections, Port 1 to CPU

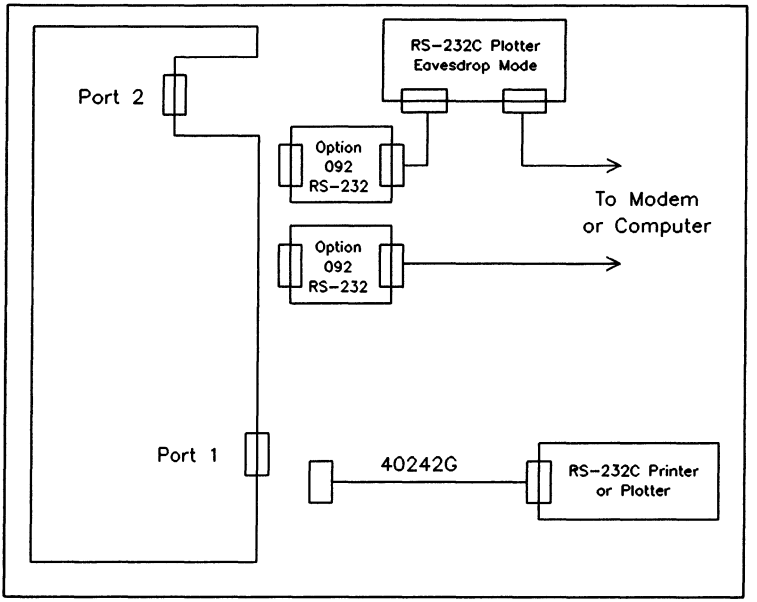

Figure 3-922 TPU Connections, Port 2 to CPU

SYSTEM	OP. SYS	I / F	DRIVER	MUX	I / O PANEL
3000 series 4X and 6X	MPE V/E	RS-232 ADCC/ATP	HIOTERM1 or HIOTERM2	----	----
3000 series 4X and 6X	MPE V/E	HP 422 ATP	HIOTERM1	----	----
1000 series M / E /F	RTE IV/IVB/VI	----	DVM 00 +DDV05	12792B	12828A
1000 series M / E / F	RTE IV/IVB/VI	12966A opt 002	DVA 05 or DVR 05	----	----
1000 series A / L	RTE L/XL/A	-----	IDM 00 and DD 00	12040B	----
1000 series A / L	RTE L/XL/A	12005 A/B	ID 00 and DD 00	----	----
3000 Series 37	MPE V / E	T.I.C	HIOTERM1	----	----

Table 3-923 HP CPU Connections

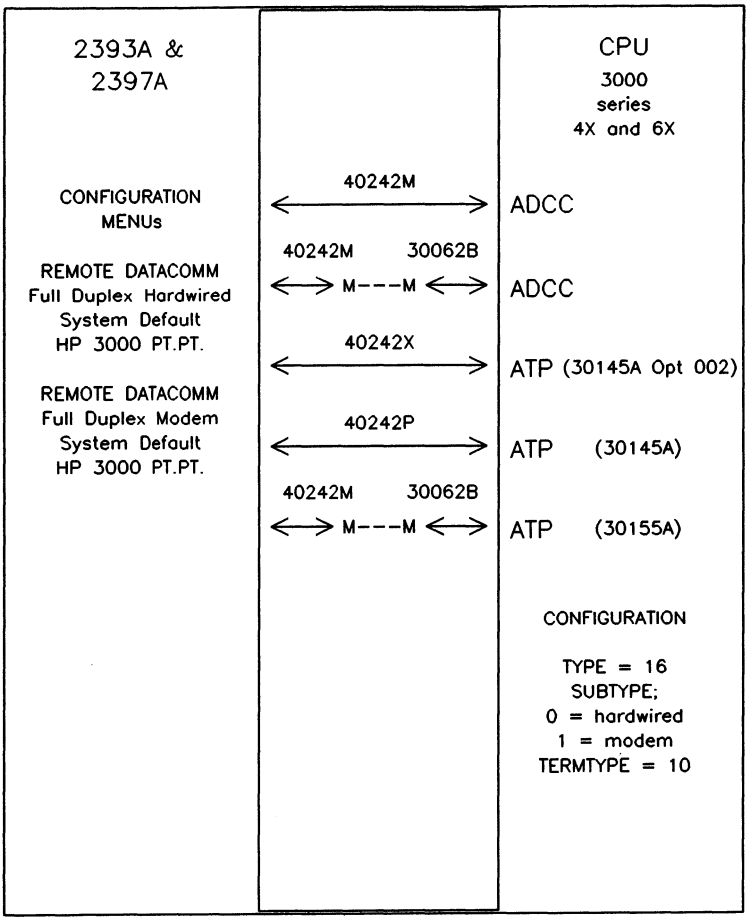

Table 3-924 TPU Connections to HP 3000 Series 4X and 6X

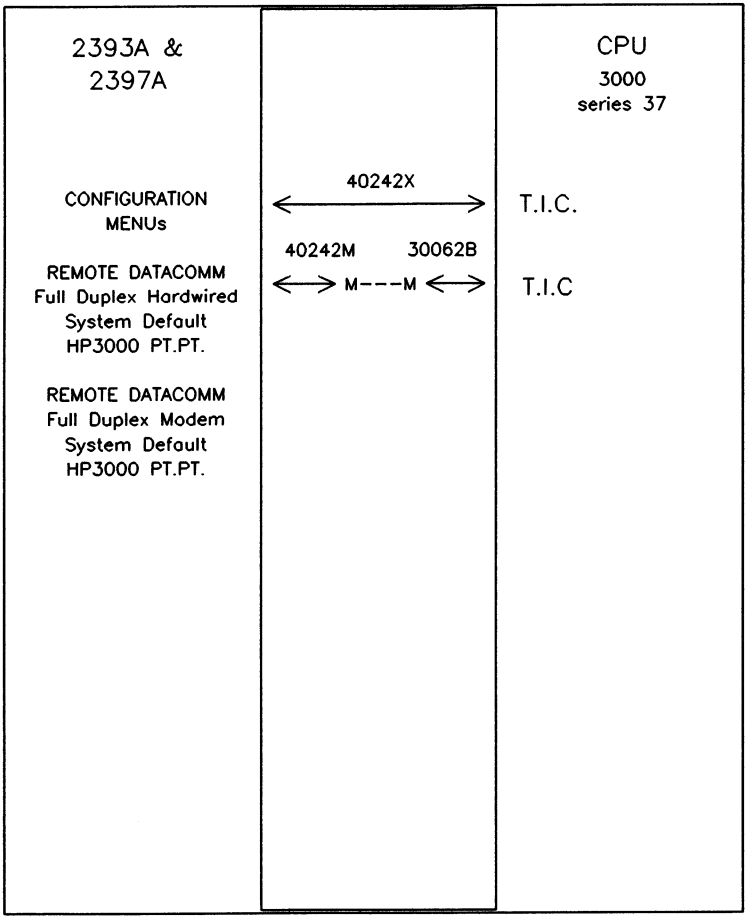

Table 3-925 TPU Connections to HP 3000 Series 37

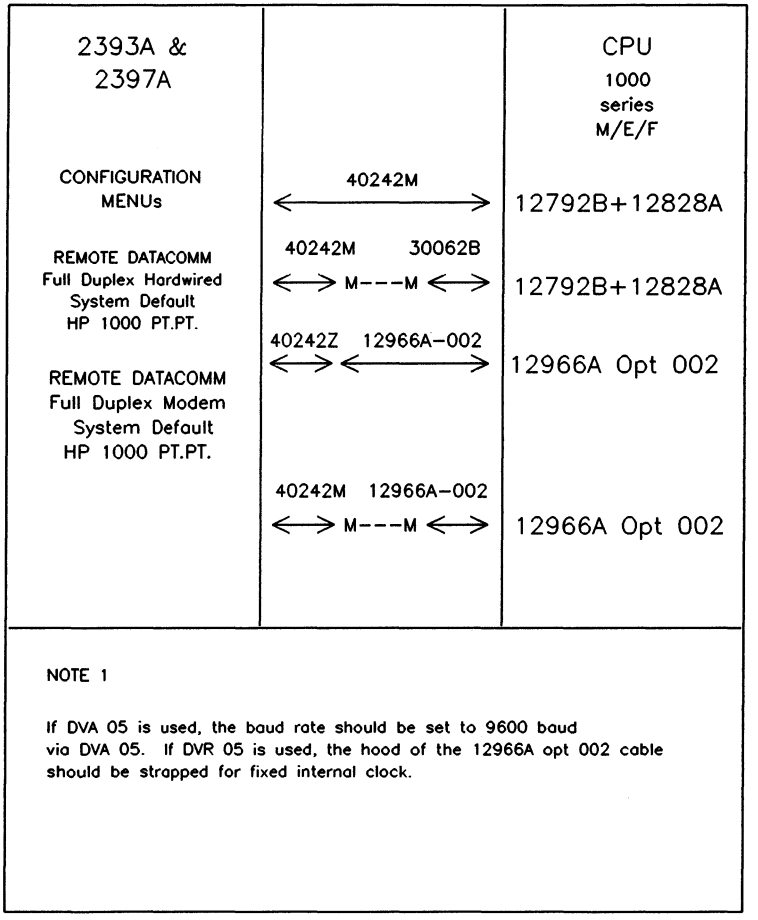

Table 3-926 TPU Connections to HP 1000 Series M/E/F

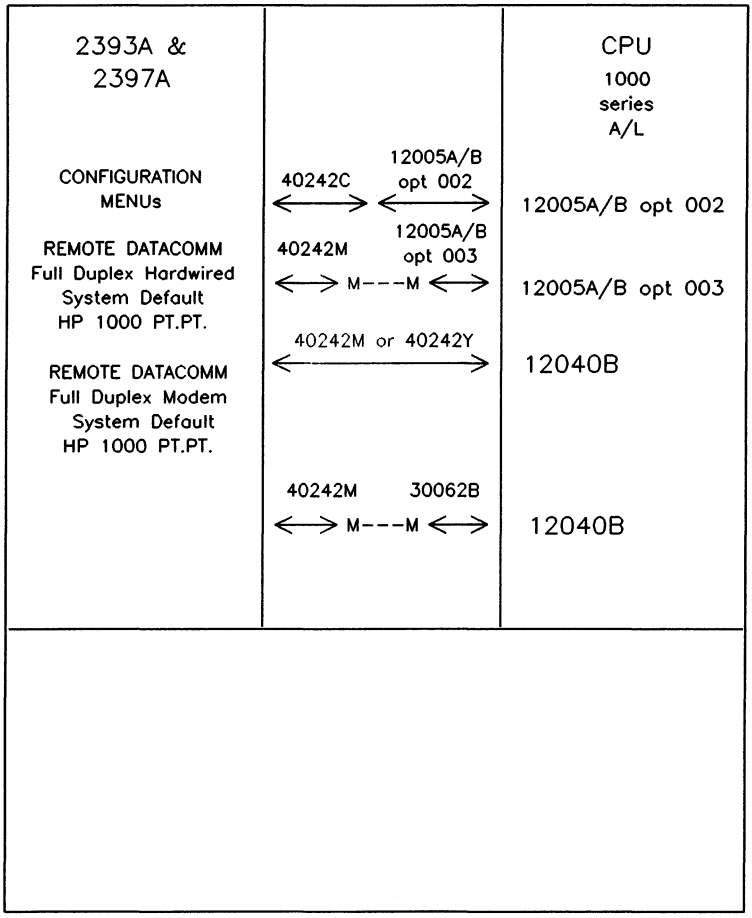

Table 3-927 TPU Connections to HP 1000 Series A/L

3.94 PERIPHERAL CONNECTIONS

Introduction

The 2393A and 2397A terminals can support external device connections to printers, plotters and other devices. The three types of connections that are available are RS232C, 8 bit parallel and HP-IB. These three external device connections are possible by installing an I/O Accessory Module in Port 2 of the 2393A and 2397A terminals. These I/O Accessory Modules may be obtained with a terminal by ordering options: 046 = HP-IB, 092 = RS-232C or 093 = 8 bit parallel. After a terminal has been purchased, an I/O Module can be ordered as an accessory using the following numbers: 40210R = RS-232C, 40210P = 8 bit parallel and 40210H = HP-IB.
There are many devices that can be hooked to each interface and a connection for each accessory will be discussed.

RS-232C CONNECTION

1. Terminal Configuration

Menu = External Serial Device Configuration
Settings = Default

2. Cable

40242G - Serial Printer Cable M25 / M25, 5m

3. Peripheral Configuration

The settings for serial printers vary from printer to printer. The important settings are listed below. The settings on the printer must agree with the settings on the terminal. In most cases, if the settings on the printer are matched to the terminal's default settings the interface will work.

Baud Rate - The default setting is 9600 baud. This is only possible if the printer supports handshaking.

Parity - The default setting is None 8, if the printer does not support the extended roman character set then the setting should be 7 bits with parity either 0's, 1's, even or odd.

Handshake - The default setting is Xon/Xoff under XmitPace. If the printer does not support Xon/Xoff handshaking then hardware handshaking can be enabled such as CS(CB)Xmit. If a printer doesn't have either type of handshaking then nulls can be inserted in the data stream or the baud rate can be lowered or both.

BIT PARALLEL CONNECTION

1. Terminal Configuration

Menu = External Parallel Device Configuration
Settings = Default

2. Cable

40242D Parallel Printer M36 to M36, 2m

3. Peripheral Configuration

Normally there are no settings for the peripheral.

HP-IB CONNECTION

1. Terminal Configuration

Menu = External HP-IB Device Configuration
Settings = Default

2. Cable

HP-IB Cable 45529A 1m (3.3 ft)
HP-IB Cable 10833A 1m (3.3 ft)
HP-IB Cable 10833B 2m (6.6 ft)
HP-IB Cable 10833C 4m (13.2 ft)
HP-IB Cable 10833D .5m (1.6 ft)

3. Peripheral Configuration

An HP-IB printer and an HP-IB plotter can be used simultaneously with option 046 connected to the terminal. The printer would be normally be at address 01 and the plotter would typically be at address 05. This allows local data transfers to the printer using the functions keys and graphics keypad.

A system can directly access the HP-IB device through the terminal and it might look for a specific HP-IB device number other than the terminal default setting of one and five.

HP-IB Device Number = ONE
Listen Always = OFF
Service Request (SRQ) = OFF

SECTION 4

PREVENTIVE MAINTENANCE

4.00 INTRODUCTION

This section provides preventive maintenance instructions for the 2393A and 2397A terminals. Preventive maintenance is the responsibility of the customer.

4.10 PLANNED MAINTENANCE PROCEDURE

There are no planned maintenance procedures for Customer Engineers. For terminal products, preventive maintenance is the responsibility of the customer.

4.20 CLEANING

Clean the display and keyboard regularly to remove dust and finger prints. Conventional spray cleaners are strong enough to clean your screen and keyboard.

CAUTION

Do not use petroleum based cleaners, (such as lighter fluid) or cleaners containing benzene, trichlorethylene, ammonia, dilute ammonia or acetone. These chemicals can attack and damage the terminal's plastic surfaces.

Avoid getting cleaner into the keyboard in the spaces between the keys. The best way to clean the screen and keyboard is to spray a nonabrasive cloth with an approved cleaning solution first, then wipe off the surfaces.

4.30 MECHANICAL

There are no mechanical maintenance procedures. The only mechanical device is the keyboard. Appearance cleaning is all that is necessary.
Convection cooling is used in this terminal replacing a noisy mechanical fan.
A quick check to insure that all cables are securely attached is encouraged.

4.40 ELECTRICAL

No electrical maintenance is required by the Customer Engineer. The customer is responsible for the brightness and contrast adjustments for the display. It can be adjusted for various background lighting conditions.
There is no battery in this terminal. Non-volatile memory is EEPROM, which retains configuration information.

SECTION 5

FUNCTIONAL DESCRIPTION

5.00 INTRODUCTION

This chapter will describe the functional operation of the 2393A and 2397A graphics terminals. These terminals share common architectures. Each terminal is composed of several PCA modules and many of these PCA modules are the same for both terminals. Each module will be described in block level detail. Internal and external connections are also described.

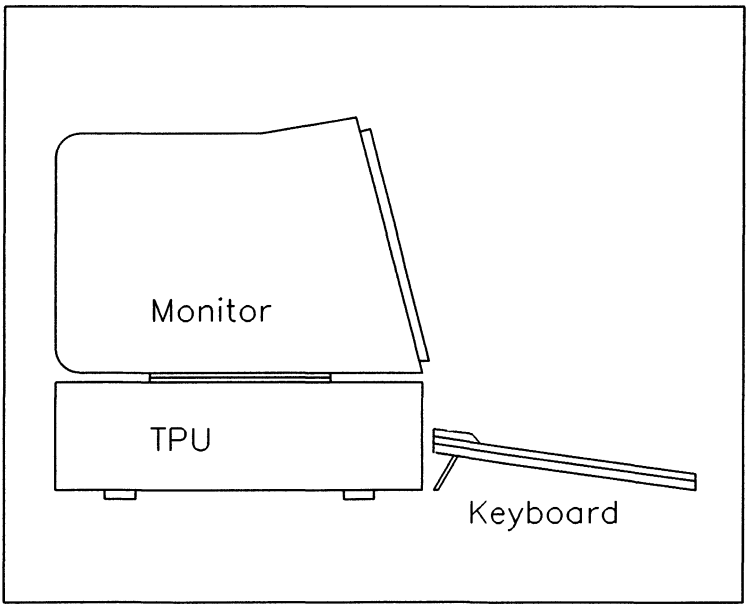

Figure 5-01 Terminal Diagram

5.01 TERMINAL DESCRIPTION

Terminal

The Terminal is composed of three major components: Monitor, Keyboard and Terminal Processing Unit (TPU). Figure 5-01 shows the major components that make up a terminal for both the 2393A and 2397A.

The Monitor can be either monochrome or color. It contains CRT, sweep and power supply circuits. The color monitor is used with the 2397A. The monochrome monitor is used with the 2393A. If more information is desired for a monitor, see the respective monitor's service manual.

The Keyboard is low profile with color-coded, sculptured keycaps. For flexibility, the keyboard can be positioned either flat or at an angle. Both the 2393A and 2397A terminals use the same keyboard depending on the national language specified.

The TPU contains the terminal's intelligence. This unit is composed of several PCA modules that determine a terminal's capabilities. The 35751M TPU is used with the 2393A graphics terminal and the 35751C TPU is used with the 2397A color graphics terminal.

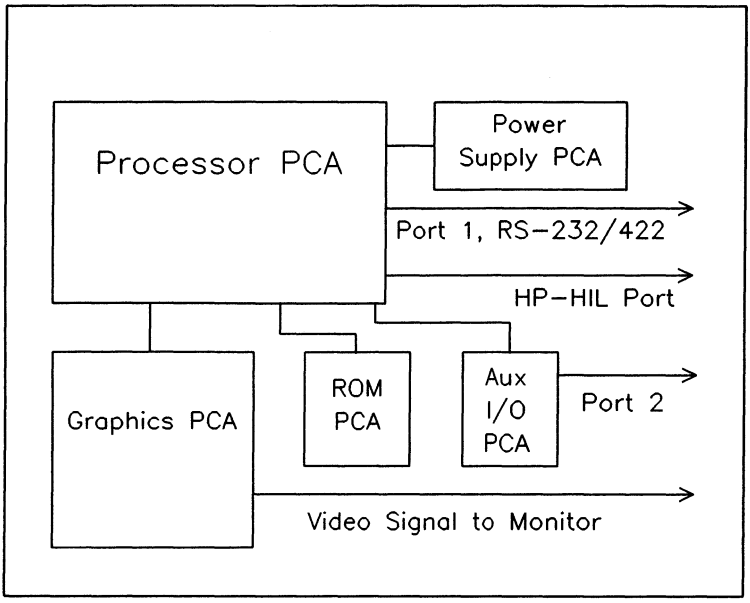

Figure 5-02 TPU Block Diagram

5.02 TPU DESCRIPTION

The Terminal Processing Unit, TPU, contains all of the terminal's intelligence. It is contained in a small metal box. Several PCA modules make up a TPU. The four basic modules are shown in figure 5-02. They are the Processor PCA, Power Supply PCA, ROM PCA and the Graphics PCA. These four modules are essential to TPU operation. All of these modules must be installed for a TPU to be operational.

The fifth module is optional, this is the Auxiliary I/O module. The Auxiliary I/O module plugs into port 2 on the TPU. It usually interfaces to an external output device such as a printer or plotter. There are four modules that can be plugged into this slot; they are the HP-IB I/O, Parallel I/O, RS-232 I/O and Test I/O modules.

The 2393A and 2397A terminals use different TPUs. The 2393A uses the 35751M TPU and the 2397A uses the 35751C TPU. These two TPUs use the same PCA modules except for the Graphics Video PCAs. The 35751M uses the Monochrome Graphic Video PCA and the 35751C TPU uses the Color Graphic Video PCA. Thus the Graphic Video PCA determines the type of TPU.

The TPU is convection cooled and therefore does not use a fan. The fan was deleted to reduce noise and eliminate fan failures. A metal case was used to provide better ESD protection and RFI performance. The TPU is held together with several screws. Screws have been used to help eliminate RFI. When replacing these screws, it is important to tighten them snugly (7 in-lbs of torque). This will keep the metal parts at ground potential so radiating signals can be shunted to ground.

Figure 5-02 shows a block diagram of the TPU. The arrows indicate signal flows external to the TPU. These external signals will be discussed with the PCA that they exit from. A solid line connecting two PCAs indicates an electrical connection between two PCA modules.

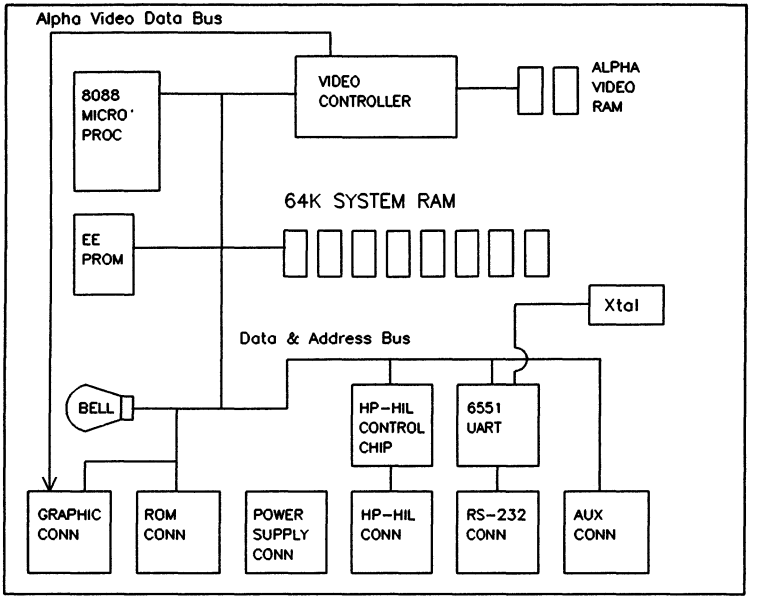

Figure 5-03 Processor PCA Block Diagram

5.03 PROCESSOR PCA DESCRIPTION

The processor PCA is the heart of the TPU. It is responsible for the transfer and processing of data throughout the TPU. The main parts of the processor PCA are listed in figure 5-03. A description of each part follows.

8088 Microprocessor

This microprocessor has a 16 bit internal architecture and an 8 bit external data bus. It can address 1 megabyte of memory. In this application it is clocked at 7.04 megahertz. The data bits and the lower 8 address bits are time multiplexed. This technique is used to reduce the lead count permitting the use of a standard 40 pin package.

Alpha Video Data Bus

The alpha data travels from the video controller to the graphic connector on the alpha video data bus. The alpha data flows through the graphics connector to the monochrome or color graphic video PCAs.

Data and Address Bus

The 8088 microprocessor controls terminal functions and transfers data via the data and address bus. Graphic data is sent to the monochrome and color graphic video PCAs on this data and address bus.

EEPROM

This IC is a 512 byte electrically erasable PROM. Configuration data is stored in this memory. Unlike most proms, this one can be electrically erased and then rewritten. This memory is non-volatile and does not need battery backup. This EEPROM is accessed normally during a read cycle, but can only be written into once every 10 milliseconds. Configuration data is stored in this memory.

System Ram

System ram contains 64k by 8 bit bytes of dynamic memory. This RAM is the main memory for the terminal. This memory is general purpose, it is used for many purposes such as data storage and buffering. System RAM consists of eight 64k x 1 bit dynamic RAMs. The support for the RAM consists of three sections; RAS/CAS generation, address multiplexing, and refresh request generation.

Bell

This speaker is located on the processor PCA and operates at 1,562 hertz. The bell is used infrequently to warn the operator of errors, end of line and successful completion of a self-test.

Xtal

A crystal clock oscillator is used to provide the 1.8432 MHz clock required by the 6551 UART. This separate oscillator is used to ensure that the baud rates are exact, and that the maximum margin exists when communicating with other sources with variations in data rates.

Video Controller

The alpha video processor chip is designed and manfactured by Hewlett-Packard Co. It is a VLSI video processor/controller that is made using an NMOS process. It is capable of providing all of the necessary timing and control for refreshing a raster scan CRT directly from video RAM. This video chip contains a CRT controller, character generator ROM, double high/wide character algorithm, cursor generator, video memory arbitrator, microprocessor interface, graphics system interface and an alpha-character color map.

This chip operates in a row-table addressing mode whereby each row on the screen is designated by its own address. This provides flexibility since the screen rows are linked by pointers instead of residing in sequential memory locations. Smooth-scrolling between any two screen rows increases the display legibility when manipulating data on the screen. Access to video memory is interleaved between the video chip and the 8088 to ensure minimum microprocessor lock out to video memory.

Alpha Video Ram

Visible display memory consists of two 8k X 8 static RAMS. The alpha display memory stores data that is currently being displayed on the CRT. The video controller has direct access to this memory. The 8088 microprocessor has indirect access through the video controller to this memory.

Graphic connector

The Monochrome Graphics PCA or the Color Graphics PCA plug into this connector. The alpha video data bus from the video controller travels to this connector as well as the main 8088 data and address bus. Power and ground are also supplied through this connector. This is a 52 pin connector with 2 rows of 26 pins. There are 41 signal lines, 6 ground, 1 at +12 volts and 4 at +5 volts.

Rom Connector

The 8088 data and address bus lines travel through this connector to a ROM PCA. The ROM PCA plugs into this slot. Power and ground are also supplied through this connector. This connector has 36 pins with 2 rows of 18 pins. There are 27 signal lines, 5 ground lines and 4 lines at +5 volts.

Power Supply Connector

The power supply attaches to this connector. It supplies the power for the entire TPU and the HP-HIL input devices. The power is distributed to the other PCAs in the TPU through the processor PCA. This power connection is a 9 pin ribbon cable with a plastic connector. The power lines are +12 volts, -12volts, +5 volts and ground. The monitor does not use any power from the terminal, it has its own power supply.

HP-HIL Control IC

The HP-HIL Control IC commands the HP-HIL. This loop is a concept developed at Hewlett-Packard Co. It allows several input devices to be chained together on one interface to the TPU. Devices can be keyboards, tablets, mice, touchscreen, bar codes and etc. All devices derive their power from the TPU via the HP-HIL connector.

HP-HIL Connector

The HP-HIL connector consists of a 4 pin receptacle, similar to a phone jack.

pin 1 = +12 volts
pin 2 = SI (serial input)
pin 3 = SO (serial output)
pin 4 = GND.

The maximum number of HP-HIL devices that this TPU can support is 4. This is determined by the amount of current the TPU can provide. The TPU can provide 500 milliamps of of current. A typical input device is defined to draw less than 150 milliamps. If a device draws more than 150 milliamps then the total number of devices could be less.

6551 Uart

The 6551 is an Asynchronous Communication Interface Adaptor (ACIA) that provides interfacing for a microprocessor to serial communication to data sets and modems. A unique feature of this IC is an on-chip programmable baud rate generator. It also provides for parallel to serial conversion, parity and stop bit generation & selection, full or half duplex transmission and data set/modem control lines.

RS-232 Connector

This is a standard 25 pin female RS-232 connector. Depending on the cable used this port will support either RS-232C or HP-422 communications. This is port 1 and it is normally hooked to a CPU. This port comes standard with both TPUs.

The following pin numbers are active;

Pin#	Signal	Description
01	Gnd	Protective Ground
02	SD	Send Data
03	RD/RDA	Receive Data (RS-232 & RS422)
04	RS	Request to Send
05	CB	Clear to Send
06	DM	Data Mode
07	AB	Signal Ground
08	CF	Receiver Ready
09	SD.A	Send Data A (422)
10	SD.B	Send Data B (422)
12	SCF	Secondary Receiver Ready *1
18	RD.B	Receive Data B (422)
19	SCA	Secondary Request to Send *1
20	CD	Data Terminal Ready
22	CE	Ring Indicator
23	CH	Data Signal Rate Selector

NOTE 1. Pins 12, SCF and pin 19, SCA are active on port 1 when port 2 has an RS-232 module installed. This is because the traces for these signals go to the port 2 connector first. Before these signals get to port 1 they must be looped back by a port 2 module.

Auxiliary Connector

The Auxiliary Connector allows for an auxiliary I/O module to be added to the TPU in the port 2 slot. Usually this port would be connected to an output device, although it can connect to a computer. The I/O modules that can be added to this port are the HP-IB I/O, Parallel I/O, RS-232 I/O and the Test I/O modules. The 8088 is connected to this interface via the data and address bus.

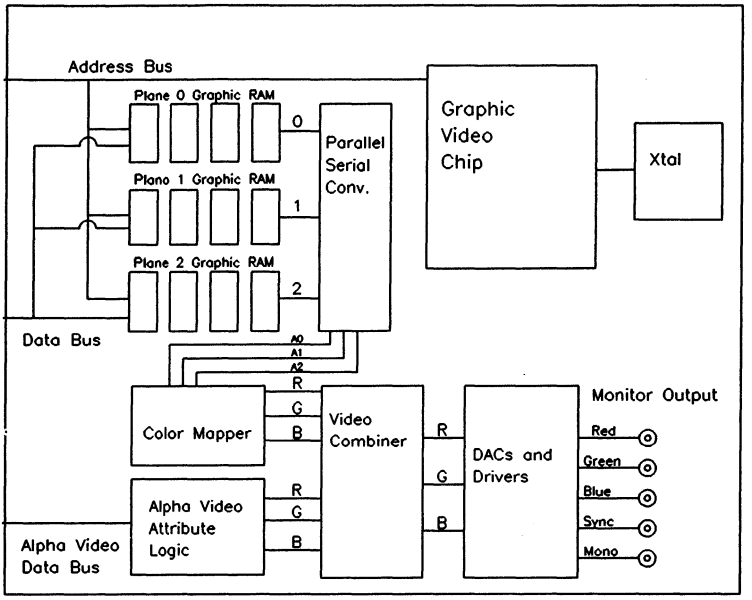

Figure 5-04 Color Graphics Video PCA

5.04 COLOR GRAPHIC VIDEO PCA

The Color Graphic Video PCA receives graphic, alpha and color digital data. It then combines and converts these signals into video signals to be sent to a monitor for viewing. Graphic data passes to this module on the 8088 data and address bus. Alpha data travels to this PCA on the alpha video data bus from the video controller located on the Processor PCA.

Graphic Video Chip

The Graphic Video IC is a graphic video controller and a multipurpose chip having several functions. It generates several of the video clock signals used by the video controller and the 8088 located on the Processor PCA. It provides graphic display refresh, graphic RAM timing signals and graphic RAM refresh. It supports the dual-mode graphic displays which consist of either 512 horizontal x 390 vertical or 640 horizontal x 400 vertical formats. This IC arbitrates graphics memory access between CPU and screen refresh cycles. It shares an address bus with the 8088 to address the graphic RAM.

Crystal (Xtal)

This crystal generates a 35.190 MHZ clock signal that is supplied directly to the Graphic Video Chip.

Graphic RAM

The Graphic RAM is arranged in 3 planes of 16k by 16 bit words. This is equivalent to three 256,000 pixel graphic planes. The three graphic planes provide memory for color data that is translated by the color mapper into eight different colors. The 8088 data bus feeds vectors and data into the graphic RAM from the processor PCA. This graphic information is updated from the 8088 microprocessor. There are 4 RAMs for each of the three planes. They are 16k by 4 bit RAMs. The Graphic Video Chip also uses this memory to refresh the graphic display on the monitor.

Parallel to Serial Conversion

The parallel to serial conversion is accomplished by 4 each, 4 bit parallel-access shift registers for each color plane. Sixteen parallel bits are shifted out of a selected RAM plane at a time. Each bank of RAM has its own set of shift registers. This places the graphic data in serial sequence for writing to the display.

Color Mapper

Due to the short dot period, 39.8 nanoseconds per pixel, the color mapping must be pipelined. The pipeline consists of video shift registers, address source selector and color mapper RAM. The content of the color mapper RAM is 6 bits wide, two bits each for the red, green and blue primary colors. The two bits select a possibility of 4 intensity levels for each of the 3 basic colors resulting in a possibility of 64 different colors. The color mapper uses the information stored in the three graphic RAM memory planes to derive the color information.

Alpha Video Attribute Logic and Dot Shift/Stretch

The Alpha Attribute Logic does the parallel to serial conversion of the alpha dot data, dot stretch and shift operation. It combines the parallel data with the color pair information to produce the three serial dot streams containing the foreground and background color video information.

Video Combiner

The Video Combiner is a multiplexer which switches between the graphics video and alpha video dot streams. Graphics is selected when alpha is in the background mode. The most significant bits of the video dot streams are selected by the same multiplexer to reduce skew between the colors.

Color Video DACs and Drivers

The Color Video Digital to Analog Converters and Drivers are discrete circuits. They are designed to convert the digital color signals provided by the color mapper, along with Sync and Blanking information into analog voltage signals to drive the color monitor. The two bit digital signals are converted to one of four intensity levels per color.

Output BNC Connectors

This set of connectors is for a monitor. It is connected with standard 75 ohm BNC to BNC cables. These output signals have their own drivers with a 75 ohm output impedance. They must drive a 75 ohm load. The sync signal is a TTL level signal. The red, green and blue signals have a sync signal included, (composite-sync). The horizontal scan rate is 25.5 khz.

The monochrome representation of the color signal is generated by weighting each color according to their relative brightness, green is the brightest, then red, then blue. This gives a wide range of separation between the gray scales for the monochrome representation of the RGB colors. This output also has a 75 ohm output impedance and must drive a 75 ohm load.

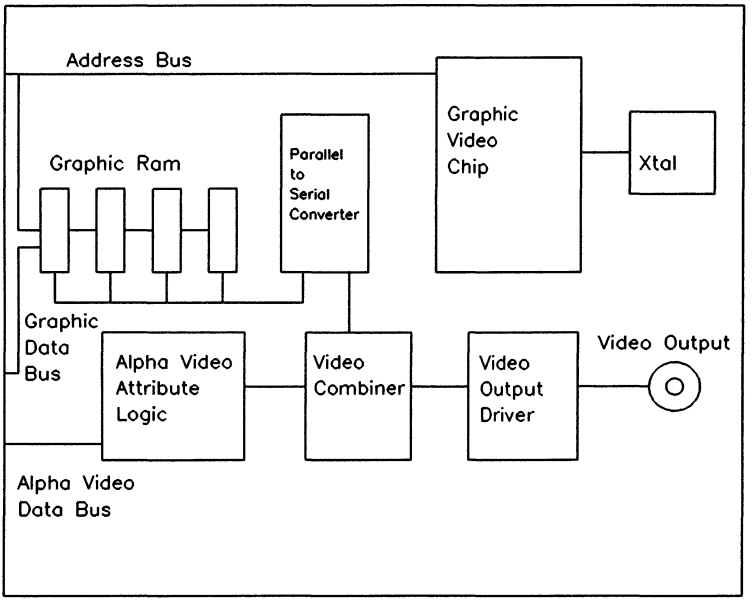

Figure 5-05 Monochrome Graphic Video PCA Block Diagram

5.05 MONOCHROME GRAPHIC VIDEO PCA

The monochrome graphic video PCA receives the graphic and alpha video signals. It combines and converts these signals into an analog composite signal to be sent to the monochrome monitor. Alpha data gets to this PCA on the alpha video bus. The graphic data gets to this PCA by way of the 8088 data and address bus.

Graphic Video Chip

The Graphic Video IC is a graphic video controller and a multipurpose chip having several functions. It generates several of the video clock signals used by the video controller and the 8088 located on the processor PCA. It provides graphics screen refresh, graphic RAM timing signals and graphic RAM refresh. It supports the dual-mode graphic displays of either 512 horizontal x 390 vertical or 640 horizontal x 400 vertical formats. This IC arbitrates graphics memory access between CPU and screen refresh cycles. It shares an address bus with the 8088 to address the graphics RAM.

Crystal (Xtal)

This crystal generates a 35.190 MHZ clock signal that is supplied directly to the Graphic Video Chip.

Graphic RAM

The graphic RAM is of a bank of memory 16k by 16 bits. This is equivalent to a 256,000 bit graphic plane. In the monochrome graphic monitor there is only one plane. The 8088 data bus lines feed data into the graphics RAM from the processor PCA. Thus, graphics information is updated from the 8088 microprocessor. There are 4 RAMS, each 16k times 4 bits that make up the graphic memory.

Parallel to Serial Converters

The parallel to serial conversion is accomplished by 4, 4 bit parallel-access shift registers. Sixteen parallel bits are shifted out of memory at a time. This places the graphic data bits in serial sequence for writing to the monitor.

Alpha Video Attribute Logic and Dot Shift/Stretch

The Alpha Attribute Logic does the parallel to serial conversion of the alpha dot data, dot stretch and dot shift operations. It supplies the alpha dot stream to the video combiner as well as the half and full bright information.

Video Combiner

The video combiner is a multiplexer that switches between the graphic video and alpha video data. Graphic data is selected when alpha is in the background mode. The most significant bits of the video data streams are selected by the same multiplexer to reduce the skew between dots.

Video DACs and Drivers

The Video Digital to Analog Converter and Driver is a discrete circuit. It is designed to convert the blanking, sync, halfbright and fullbright signals into a composite signal to drive the monochrome monitor.

Video BNC Output Connector

There is one output BNC connector for the monochrome monitor. It is a composite video signal that is a composite of the blanking, sync, halfbright and fullbright signals. This output has a 75 ohm output impedance and must drive a 75 ohm load. The horizontal scan rate is 25.5 khz.

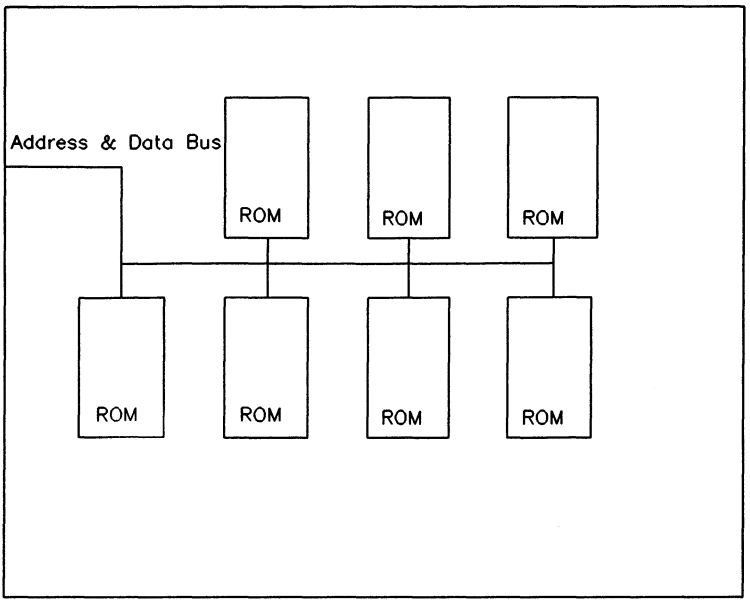

Figure 5-06 ROM PCA Block Diagram

5.06 ROM PCA DESCRIPTION

The ROM PCA contains 7 read only memories that are 32k by 8 bits. The instruction set for the terminal is contained in these ROMs and is arranged in 8 bit bytes. There are 32,768 bytes in each ROM memory. This instruction set is a list of commands that provide the terminal its intelligence. This ROM Module contains the instructions for all National Options, Color Graphics, Monochrome Graphics and ANSI terminal functions. There are a total of 229,376 bytes of code on the ROM Module.

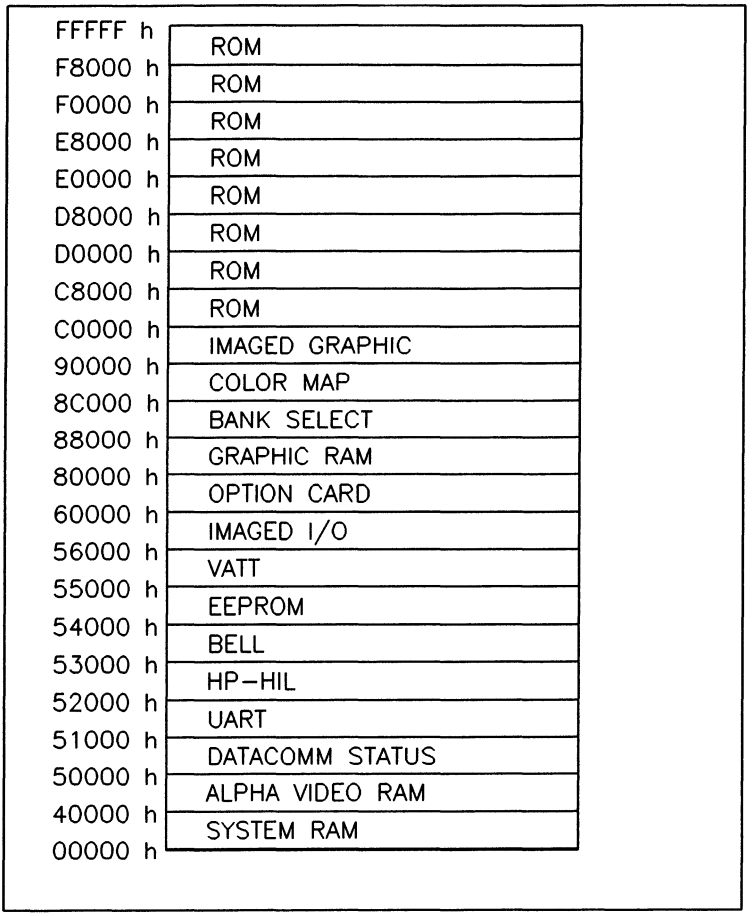

Table 5-07 Memory Map

5.07 MEMORY MAP DESCRIPTION

The memory map is a list of address locations that different memories occupy. The 8088 can directly access up to 1 million address locations. These locations are in hexadecimal form. Some locations in memory are not fully used.

On the 2397A, graphics memory planes have starting addresses of:

Plane 0 = 80000H
Plane 1 = 90000H
Plane 2 = A0000H

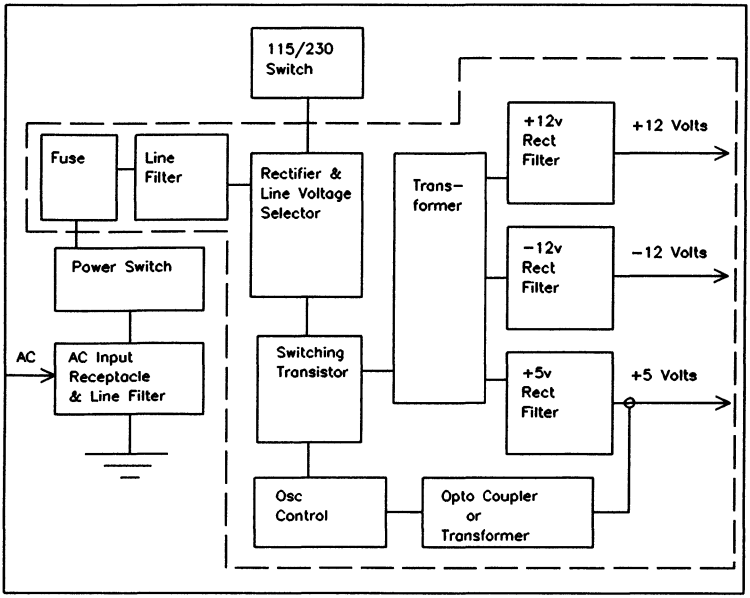

Figure 5-08 Power Supply PCA

5.08 POWER SUPPLY PCA DESCRIPTION

This power supply is used in the 35751M and 35751C TPUs, which are used in the 2393A and 2397A graphic terminals. In figure 5-08 note that the Power Supply PCA is outlined by the dashed line. Blocks outside that dashed line are not part of the Power Supply PCA. This module can be used at 115 volts or 230 volts AC. The fuse is soldered in and if it opens the power supply PCA must be replaced. One size fuse is used for both 115 volt and 230 volt applications.

AC Input Receptacle and Line Filter

This is a self-contained module that mounts on the back panel of the terminal and is agency approved.

Power Switch

The power switch is double pole and switches both neutral and line. It is the push-on push-off type that is remotely actuated by an extender rod from the front panel. It is mounted on the card cage separate from the power supply PCA.

Fuse

The fuse is non-replaceable and is mounted on the power supply PCA. It works for both 115 and 230 volt operation.

Line Filter

There are some additional filtering components located on the power supply PCA.

Rectifier and Voltage Selector

The rectifier can be either a bridge or voltage doubler type. This circuit also contains circuits to change between 115 and and 230 volts ac operation depending on the position of the 115/230 switch.

115/230 Switch

This switch is located on the back panel. It allows the power supply to be operated at either 115 volts ac or 230 volts ac.

Switching Transistor

This transistor is controlled by the Oscillator Control. It regulates the flow of energy from the storage elements in the rectifier section to the primary of the Transformer.

Transformer

This is a high isolation transformer with three secondary windings. It steps down the rectified line voltage for three different DC outputs.

Rectifier Filter +12 volts

This is a simple half-wave rectifier with LC filtering.

Rectifier Filter -12 volts

This is a simple half-wave rectifier with LC filtering.

Rectifier Filter +5 volts

This is a simple half-wave rectifier with LC filtering.

Opto Coupler or Transformer

Either one of these devices might be used to feed back the voltage changes of the +5 volt output to the Oscillator Control. Both methods provide a high degree of isolation.

Oscillator Control

The Oscillator Control turns the Switching Transistor on and off at a frequency determined by the feedback through the Opto Coupler or Transformer, thus maintaining a constant +5 volts output under all conditions of a load.

5.20 DESCRIPTION of ACCESSORIES

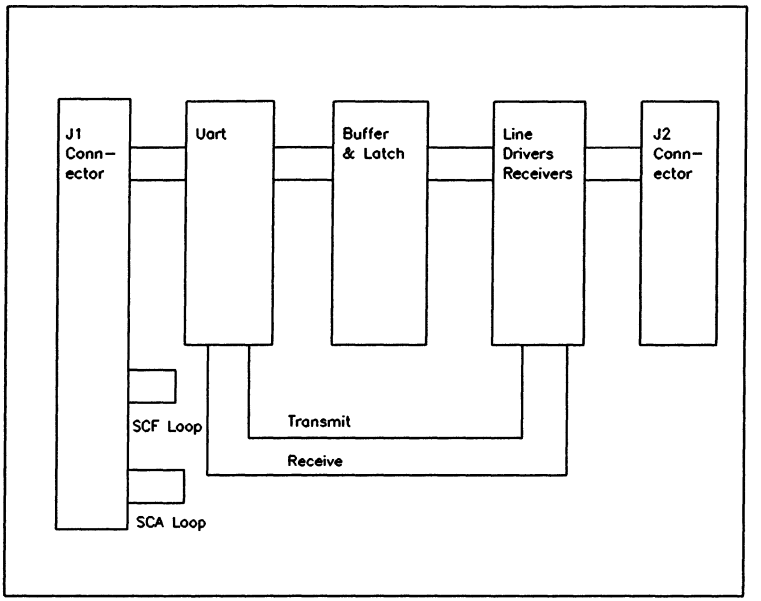

Figure 5-21 RS-232 I/O Module

5.21 RS-232 I/O MODULE

This module communicates with RS-232 external devices.

J1 Connector

This connector plugs into the processor PCA. The data/address bus, power and timing signals are supplied through this connector.

SCF / SCA

This I/O module enables signals SCF and SCA on port 1.

Uart

This IC communicates on the data/address bus. It converts parallel data from the processor to serial data to be sent over the RS-232 interface.

Buffer/Latch

The buffer is used for incoming signals and the latch for out going signals.

Line Drivers / Receivers

Some ICs drive the RS-232 lines to an external device, CPU or modem. Others process incoming RS-232 signals. The A9636AC is used for the drivers and the A9637AC is used for the line recievers. EMP protection is provided on pin 2, transmit data out.

J2 Connector

This is an RS-232 25 pin, female connector. The active signal lines supported from the terminal are listed below.

pin 1, GND = Shield Ground.

pin 02, BA = Transmitted Data, from this module.

pin 03, BB = Received Data, to this module.

pin 04, CA = Request to send, from this module.

pin 05, CB = Clear to send, to this module.

pin 06, CC = Data Set Ready, to this module.

pin 07, AB = Signal Ground.

pin 12, SCF = Secondary Request to Send, from this module.

pin 19, SCA = Secondary Clear to Send, to this module.

pin 20, CD = Data Terminal Ready, from this module.

pin 22, CE = Ring Indicator, to this module.

pin 23, CH = Data Signal Rate Selector, from this module.

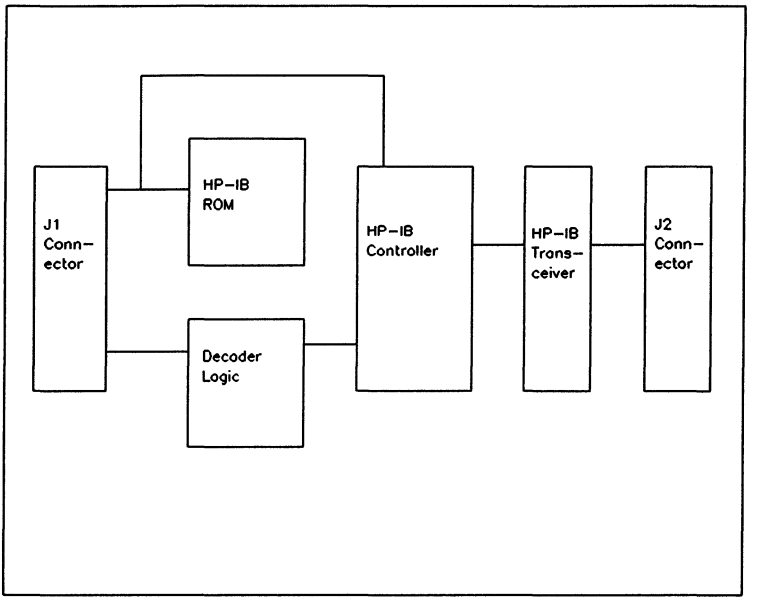

Figure 5-22 HP-IB I/O Module

5.22 HP-IB I/O MODULE

This is a byte serial bit parallel asynchronous interface system. This interface follows the IEEE 488 standard. Typical data rates approch 250 to 500 kilobytes a second. HP-IB stands for Hewlett-Packard Interface Bus. Hardware handshaking is part of the HP-IB interface standard.

J1 Connector

This connector interfaces the HP-IB module to the 8088 data/address bus. It plugs into the processor PCA.

Decoder Logic

This logic decodes the timing pulses coming from the processor PCA.

HP-IB ROM

This ROM contains the instruction set to operate the HP-IB module. It is accessed by the 8088 microprocessor resident on the processor PCA over the data/address lines.

HP-IB Controller

The HP-IB controller is the TMS9914A. It is used as an interface between the 8088 microprocessor and the IEEE-488 interface bus. It handles the IEEE-488 bus protocol.

HP-IB Transceivers

There are two transceivers. One buffers the input and output data lines and the other buffers the input/output management lines.

J2 Connector

This is a standard IEEE 488 port. It interfaces the HP-IB module to an external device using the following signals.

pins 1-4 &
pins 13-16 = Data input/output lines.
pin 5, EOI = End or identify, indicates last data byte of a multibyte sequence.
pin 6, DAV = Data valid, this line is controlled by the HP-IB module.
pin 7, NRFD = Not ready for data, this line is controlled by the listening device.
pin 8, NDAC = Not data accepted, this line is controlled by the listening device.
pin 9, IFC = Interface clear, initializes the HP-IB system to an idle state.
pin 10, SRQ = Service request, alerts the HP-IB module to a need for communication.
pin 11, ATN = Attention, causes all external devices to interperet data on the bus as a controller command.
pin 17, REN = Remote enable, enables external devices to respond to remote program control when addressed by the HP-IB module.
pins 18-24
& pin 12 = Grounded lines.

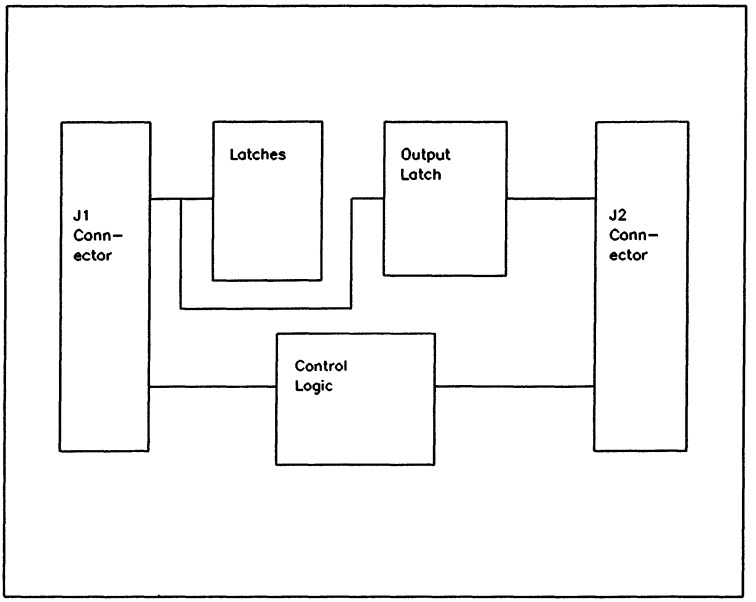

Figure 5-23 Parallel I/O Module

5.23 PARALLEL I/O MODULE

This module has the ability to communicate to an external device over a CENTRONICS style parallel interface. Data is transfered bit parallel, byte serial. This is not a full implementation of the CENTRONICS style parallel interface. Some control lines have been omitted. The ones included are listed below.

J1 Connector

This connector plugs into the processor PCA. The 8088 microprocessor controls this module over the data/address bus.

Latches

These two Latches store the module ID for the 8088 processor and latch the busy signal from the external device to the processor.

Output Latch

This latch receives data from the data bus and drives the output data lines.

Control Logic

This logic controls the timing and handshaking lines between the external device and the parallel I/O module.

J2 Connector

J2 is a female 36 pin connector.

The active signals on this connector are listed below;

pin 2-9, Data 0-7 = Output data levels to the external device.

pin 1, Not Data Strobe = A clock signal used to clock Data from the parallel module to the external device. This is a 1 microsecond pulse.

pin 10, Not Ack = The acknowledge pulse indicates the input of a character into memory or the completion of a function by the external device.

pin 11, Busy = A signal that indicates that the external device cannot recieve data.

pin 31, Reset = Sometimes called Not Input Prime, this signal clears the external device's buffers and initializes its logic.

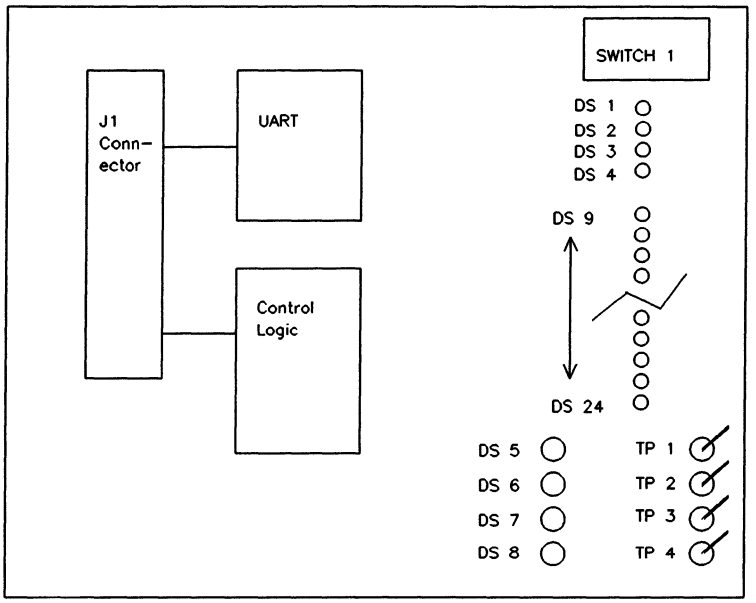

Figure 5-24 Test I/O Module

5.24 TEST I/O MODULE

This module can be plugged into port 2 the Auxiliary I/O slot. It is for testing purposes. You can monitor Power Supply Voltages and monitor the status of the Processor PCA. There is a Test Module Test that reports errors to the Test I/O Module. See section 8.50 Self-Test Operating Instructions and 8.60 Self-Test Error Codes for details of this test.

J1 Connector

This connector plugs into the Processor PCA. Power, data and address lines and timing signals are supplied through this connector to the Test I/O module.

UART

To the 8088 processor this module looks like another I/O module. The function of the UART to make this Test Module look like another I/O module with a unique address.

Control Logic

This logic is composed of several ICs to provide the necessary latching and interfacing to the LEDs and switch.

Switch 1

This is a three position switch. It is not used for the 2393A and the 2397A terminals.

DS1 through DS4

These four LEDs provide status for the Test Module Test. DS1 is the most significant bit and DS4 is the least significant bit.

DS9 through DS24

These LEDs are not used for the 2393A and 2397A terminals.

DS5

When lighted this red LED indicates that plus five volts is present on the Processor PCA.

DS6

When lighted this green LED indicates that plus twelve volts is present on the Processor PCA.

DS7

When lighted this yellow LED indicates that minus twelve volts is present on the Processor PCA.

DS8

This red LED blinks on and off to indicate activity on the 8088 address lines 15 and 16. When blinking this LED is an indication that the Processor PCA is functional.

TP1

Plus five volts can be monitored from this test point.
+5 volts output: +4.75V to +5.25V

TP2

Plus twelve volts can be monitored from this test point.
+12 volts output: +10.7V to +13.8V

TP3

Minus twelve volts can be monitored from this test point.
-12 volts output: -10.7V to -13.8V

TP4

Ground, this point can be used as a reference ground for voltmeters and other instruments.

NOTE

The keyboard or some other HP-HIL device must be connected to the TPU when making these voltage measurements (the +12volts needs a load).

SECTION 6

REMOVAL and REPLACEMENT

6.00 INTRODUCTION

The 2393A and 2397A terminals have been designed for modular repair. This section provides instructions for removing and and replacing modules, assemblies, and components which are designated as field replaceable parts. The following paragraphs describe the removal and replacement procedures.

6.10 SAFETY CONSIDERATIONS

HIGH VOLTAGE

There is either 115v or 230v present inside the TPU. This is the line voltage that is delivered to the power supply from the wall receptacle.

WARNING

Hazardous voltages are present inside the TPU. Injury or death may result if discharge occurs to an unprotected person. Always set the power switch to off and unplug the line cord from the TPU when working inside the TPU. Removal and replacement procedures contained in this section shall be performed by qualified personnel only.

A secondary consideration is to disconnect other cables connecting the TPU to input devices, monitor, printer, and plotter when servicing the TPU.

6.20 ESD CONSIDERATIONS

Electrostatic Discharge (ESD)

ESD is a static difference of potential (voltage) which is usually generated through friction of insulating materials. People can generate high voltage potentials which can be discharged into electronic equipment causing damage to that equipment.

CAUTION

When the TPU is disassembled it is extremely vulnerable to ESD. Use proper ESD procedures when opening the TPU and handling any of the TPU subassemblies or components.

A portable static-free workstation shall be used when disassembling the TPU. The static-free workstation will drain away any harmful electrical charges that could damage the equipment when it is opened. If there are further questions see the "Materials Handling and Packaging Guide" part number 5957-3967. A tabletop static mat can be purchased through the "Computer Users Catalog", HP part number 5953-2450.

6.30 REQUIRED TOOLS

Tools that are necessary for assembly and disassembly of the 2393A and 2397A terminals are as follows;

1. #2 Pozidriv (screwdriver)
2. 9/16 Wrench
3. Table Top Static Mat
4. Small Flatblade Screwdriver
5. 3mm Nut Driver
6. 4mm Nut Driver
7. 3/16 Nut Driver
8. Needle Nose Pliers

6.40 DISASSEMBLY and REASSEMBLY

When following the procedures listed below, observe the Safety and ESD considerations. Use the required tools to prevent damage to the terminal and do not force fit parts, they should fit or slide together easily. The instructions have been laid out in sequential order to guide the repair person through module, assembly and component replacement. The TPU has a layered construction and it will be necessary to remove some modules to get to others.

To help follow these procedures refer to Section 12 DIAGRAMS, for illustrations that can be used as a helpful reference.

6.41 KEYBOARD

**** Required Tools**

None

**** Removal Procedure**

1. Turn off the TPU.

2. Locate the HP-HIL cable that connects the keyboard to the TPU. Grasp the two dot connector that plugs into the TPU. Squeeze the two tabs together and pull the connector out of the TPU.

3. Unplug the other end of the HP-HIL cable from the keyboard by grasping the one dot cable connector on both sides, squeezing the two tabs together and pulling out.

4. Remove the keyboard cable from the cable run at the rear of the keyboard.

**** Replacement Procedure**

1. Turn off the TPU.

2. Locate the two dot end of the HP-HIL cable and plug it into the two dot connector on the rear panel of the TPU.

3. Take the one dot connector on the other end of the HP-HIL cable and plug it into the one dot connector on the keyboard.

4. Route the HP-HIL cable through the cable run on the keyboard.

NOTE: This procedure assumes that the keyboard is the only HP-HIL input device. If there other HP-HIL input devices then refer to the procedures in paragraph 6.42 HP-HIL DEVICES.

6.42 HP-HIL DEVICES

The HP-HIL devices are used to input data to the terminal. The most commonly used input device is the keyboard. Other input devices include touchscreen, mouse, tablet and bar code reader. All of these devices can be hooked to the HP-HIL interface or a combination of these devices. It is possible to connect up to four input devices to the 2393A or 2397A terminals.

Be sure to turn off the TPU power before removing or adding HP-HIL devices. HP-HIL devices are connected in series. They are joined together using the HP-HIL cable, (46020-60001). Each input device has two receptacles, the first is labeled with one dot the other is labeled with two dots.

Each cable has a one dot connector and a two dot connector that must be matched with a like receptacle on an HP-HIL Device. The connector on the terminal that begins the HP-HIL loop is a two dot receptacle.

The touchscreen is an HP-HIL device but it does not have the standard HP-HIL connectors on it. Instead it plugs into the the monitor and the monitor has the HP-HIL connectors on its rear panel.

See figure 12-424 for an illustration of devices connected on an HP-HIL interface off the TPU.

**** Required Tools**

1. None

**** Removal Procedure**

1. Turn off the TPU.
2. Identify the HP-HIL device to be removed.
3. Remove the cable connected to the one dot connector on this device. Grasp the one dot cable connector on both sides and pull out.
4. Remove the other end of this of this cable, the two dot end from the next device. Lay the cable aside.
5. Remove the remaining two dot cable connector from the device to be removed and put it into the two dot connector on the next device where the cable was just removed.

**** Replacement Procedure**

1. Turn off the TPU.

2. Decide where the input device is to be added.

3. A HP-HIL cable is needed. Plug the one dot end into the device to be added.

4. If the device is to be added on the end device, plug the two dot cable connector to the device to be added to the two dot receptacle on the end device.

5. If the device is to be added inbetween devices, unplug the two dot connector from the device the new HP-HIL unit will plug into. Call this device number 1. The device to be added will become device 2. Plug in the two dot connector from device 2 into the two dot receptacle on device 1. The device just removed from the link will now become device 3. Plug the two dot connector on this device into the two dot receptacle on device 2, the device just added.

6.43 MONITOR

The monitor is the display for the terminal. Normally it will stack on top of the TPU. If a touchscreen is installed on the monitor then it will have HP-HIL cables hooked to its rear panel. Do not hook HP-HIL cables to the monitor if a touchscreen is not installed on the monitor.

**** Required Tools**

1. None

**** Removal Procedure**

1. Turn off the TPU.
2. Turn off the Monitor.
3. Disconnect the video cable or cables between the TPU and Monitor.
4. Disconnect the power cord from the Monitor.
5. Disconnect the HP-HIL cables if they are attached to the monitor.
6. Remove the Monitor from the TPU.

**** Replacement Procedure**

1. Turn off the TPU and place the monitor on top of it.
2. Connect the video cable or cables between the monitor and the TPU.
3. Connect the HP-HIL cable or cables to the Monitor if the monitor has a touchscreen installed. Do not attach HP-HIL cables to the monitor if there is no touchscreen installed.
4. Connect the Monitor power cable.

6.44 ACCESSORY MODULE

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. Table Top Static Mat

**** Removal Procedure**

1. Turn off the TPU.
2. Position the back panel of TPU Module towards the repair person.
3. Unscrew the two screws securing the Accessory Module.
4. Gently but firmly pull and wiggle Accessory Module from the TPU Module.

**** Replacement Procedure**

1. Turn off the TPU.
2. Position the back panel of the TPU towards the repair person.
3. Remove the Accessory Module cover plate if necessary. Two screws secure it.
4. Insert the Accessory Module in the Accessory Module slot and push the module into its respective connector.
5. Insert and secure the two screws that hold the Accessory Module in place.

6.45 ROM MODULE

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. Table Top Static Mat

**** Removal Procedure**

1. Turn off the TPU.
2. Position rear panel of TPU assembly toward the repair person.
3. Unscrew the two screws securing the ROM module cover.
4. Now use the ROM module cover as a tool to remove the ROM module. Position the hole in the ROM module cover over the post on the ROM module and pull the module out of the TPU.

**** Replacement Procedure**

1. Turn off the TPU.
2. Position the ROM module in the Rom module track and push the ROM module into its respective connector.
3. Put the ROM module cover over the ROM module and secure the two screws.

6.46 TPU INNER MODULE

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. Table Top Static Mat

**** Removal Procedure**

1. All cables should be detached from the TPU.

2. Be sure the power cord is unplugged from the TPU.

3. Position the TPU on a side with the bottom facing the repair person.

4. Unscrew the four bottom screws with the #2 pozidriv.

5. Position the TPU on its bottom with the back panel facing the repair person.

6. Go to paragraph 6.44 ACCESSORY MODULE Removal Procedure. Follow those directions for removal of the Accessory Module.

7. Unscrew the 2 screws securing the ROM module cover plate with a #2 pozidriv screwdriver and remove this cover plate.

8. Unscrew the 2 flat head screws located under the ROM and Accessory Modules on the bottom of the back panel with a #2 pozidriv.

9. Unscrew the 4 pan head screws along the top and bottom of the back panel with a #2 pozidriv screwdriver.

10. Pull the TPU Inner Module out of the TPU Box aproximately 3 inches.

11. Now grasp both sides of the back panel and pull the TPU Card Cage out of the TPU Box.

12. Place the TPU Card Cage on top of the anti-static mat.

**** Replacement Procedure**

1. Place the TPU Box with the front panel down and the rear panel up on the work surface.

2. Pull off, the on/off button on the end of the extender arm. This is located on the TPU Inner Module. Be sure the power cord is unplugged from the TPU Inner Module.

3. Pick up the TPU Inner Module on both sides and lower it down into the TPU Box.

Note. If the TPU Inner Module does not drop into place, check the power on/off switch extender arm to see if it is aligning with the hole for it in the front panel.

Also be sure the front edge of the Processor PCA fits in between the two prongs of each of the three tabs located on the front inner side of the TPU box.

4. Place the TPU on its bottom with the rear panel facing the repair person.

5. Replace the four pan head screws into the top and bottom of the rear panel.

6. Replace the two flat head screws below the ROM and Assembly Module slots in the rear panel.

7. Position the TPU on its side with the bottom facing the repair person.

8. Replace the 4 screws in the bottom of the TPU.

9. Place the TPU on its bottom and press the blue on/off switch button into place.

10. Push the on/off switch button in and out a couple of times to be sure it is operational.

11. Replace the ROM module cover plate and the two screws securing it to the rear pannel with a #2 pozidriv screwdriver.

12. Go to paragraph 6.44 ACCESSORY MODULE Replacement Procedure. Follow those directions for replacement of the Accessory Module.

6.47 POWER SUPPLY

WARNING

The removed power supply can retain charges with voltages in excess of 100 volts. Injury or death may result if discharge occurs to an unprotected person.

**** Required Tools**

1. #2 Pozidriv (screwdriver)
2. Table Top Static Mat

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow these directions for removal of the Inner Module.

2. The TPU Inner Module is on its bottom with the front facing the repair person.

3. Unplug the two pin plastic connector (P1) on the Power Supply PCA. This is the AC line input from the on/off switch.

4. Unplug the single pin ground connector from the lug on the Power Supply PCA.

5. Unplug the 8 pin ribbon cable connected to the Power Supply PCA.

6. Unplug the the two wires on the power supply that connect to the 115v/230v switch.

7. Unscrew the 4 screws securing the Power Supply PCA.

8. Lift off the Power Supply PCA from the TPU Inner Module.

**** Replacement Procedure**

1. Place the TPU Inner Module on its bottom with the front facing the repair person. Be sure the power cord is removed from the TPU Inner Module.

2. Place the Power Supply PCA on the TPU Card Cage with the connectors toward the rear panel.

3. Check that the Power Supply PCA is not on top of any cables.

4. Insert the 4 screws into the Power Supply PCA and tighten to the TPU Inner Module.

5. Plug in the single pin ground cable connector to the lug on the Power Supply PCA.

6. Plug in the 8 pin ribbon cable connector to the 8 pin receptacle on the Power Supply PCA.

7. Plug in the two pin plastic connector to P1 of the Power Supply PCA. This cable connects to the power switch.

   NOTE, this cable carries the incoming line voltage. One wire is N(neutral) the other is L(line). The brown wire should correspond to Line and the blue wire should correspond to Neutral.

   It is important that the incoming signals are not crossed when plugged into the Power Supply PCA. These signals are marked on the line receptacle/filter and the Power Supply PCA.

8. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow these directions for replacement of the TPU Inner Module.

6.48 MONOCHROME GRAPHIC VIDEO

**** Required Tools**

1. 9/16 Wrench
2. #2 Pozidriv (Screwdriver)
3. Table Top Static Mat
4. Needle Nose Pliers

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow these directions for removal of the TPU Inner Module.

2. The TPU Inner Module is on its bottom with the rear panel facing the repair person. Be sure the power cord is removed from the TPU Inner Module.

3. Using the 9/16 Wrench unscrew and remove the nut and washer securing the BNC connector to the TPU rear panel.

4. Now turn the TPU Inner Module on its bottom with the front facing the repair person and the rear panel away from the repair person.

5. Lift the front edge of Video PCA until the multipin connector and retainer post are disconnected. To disconnect the retainer post you must depress a retainer tab while lifting on the Video PCA; this might require a pair of needle nose pliers.

6. Now pull the Video PCA free from the back panel.

**** Replacement Procedure**

1. The TPU Inner Module is on its bottom with the rear panel away from the repair person. Be sure the power cord is removed from the TPU Inner Module.

2. Slide the BNC connector on the PCA into the hole for it on the back panel. The Video PCA should be component side down and the back edge of the card should slide in between the two guide tabs on the back panel.

3. The Viedo PCA should be pressed down into place. This will engage the multipin connector and the retainer post.

4. Replace the nut and washer that secures the BNC connector to the TPU back panel.

5. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure and follow these directions for replacement of the TPU Inner Module.

6.49 COLOR GRAPHIC VIDEO

**** Required Tools**

1. 9/16 Wrench
2. #2 Pozidriv (Screwdriver)
3. Table Top Static Mat
4. Needle Nose Pliers

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow these directions for removal of the TPU Inner Module.

2. Place the TPU Inner Module on its bottom with the rear panel facing the repair person. Be sure the power cord is removed from the TPU Inner Module.

3. Using the 9/16 Wrench unscrew and remove the nuts and washers securing the 5 BNC connectors to the rear panel.

4. Now rotate the TPU Inner Module with the rear panel away from the repair person.

5. Lift the front edge of Video PCA until the multipin connector and retainer posts are disconnected. To disconnect the retainer posts you must depress a retainer tab while lifting on the Video PCA. It might be necessary to use a pair of needle nose pliers to depress the retainer tabs.

6. Now pull the Video PCA free from the back panel.

**** Replacement Procedure**

1. Place the TPU Inner Module on its bottom with the rear panel away from the repair person. Be sure the power cord is removed from the TPU Inner Module.

2. Slide the BNC connectors on the PCA into the holes for them on the back panel. The PCA should be component side down and the back edge of the card should slide between the two guide tabs on the back panel.

3. Now align the multipin connector and the two retainer posts and then press the Video PCA into place.

4. Rotate the TPU Card Cage so the back panel faces the repair person. Replace a lock washer and nut on each BNC connector and tighten with the 9/16 nut driver.

5. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow these directions for replacement of the TPU Inner Module.

6.491 PROCESSOR

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. 9/16 Wrench
3. Table Top Static Mat
4. 3/16 Nut Driver
5. Needle Nose Pliers

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow these directions for removal of the TPU Inner Module.

2. Go to paragraph 6.47 POWER SUPPLY Removal Procedure. Follow these directions for removal of the Power Supply.

3. Go to paragraph 6.48 MONOCHROME GRAPHIC VIDEO or 6.49 COLOR GRAPHIC VIDEO Removal Procedure which ever your TPU contains. Follow these directions for removal of the Graphic Video PCA. Be sure the power core is removed from the TPU Inner Module.

4. Position the TPU Inner Module so the rear panel faces the repair person.

5. Remove the on/off switch push rod by holding the push rod with one hand and the on/off switch arm with the other hand and pulling the two apart.

6. Unscrew and remove the two lock nuts that secure the RS-232 connector to the rear panel using the 3/16 inch nut driver.

7. Unscrew and remove the screw and nut that secures the HP-HIL connector to the back panel with the #2 Pozidriv.

8. Remove the two screws securing the processor to the TPU Inner Module using the #2 pozidriv.

9. Separate the Processor PCA from the TPU Inner Module.

10. Unplug the ROM module from the Processor PCA.

**** Replacement Procedure**

1. Be sure the power cord is unplugged from the TPU Inner Module.

2. Slide the Processor PCA onto the TPU Inner Module with the rear panel facing the repair person. Be sure the front edge of the processor PCA fits inbetween the tabs for it on the back panel and card cage.

3. Insert the two screws securing the Processor PCA to the TPU Inner Module with the #2 pozidriv.

4. Replace the two lock nuts securing the RS-232 connector to the back panel with the 3/16 nut driver.

5. Replace the screw and nut that secures the HP-HIL connector to the rear panel with the #2 pozidriv. The head of the screw is on the external side of the rear panel.

6. Replace the ROM module by sliding it into the slot for it in the rear panel. Be sure not to bend pins when making the connection between the ROM module and the Processor PCA.

7. Replace the on/off switch push rod. When pushing the push rod onto the arm of the on/off switch be sure the front tab of the push rod is aligned with the slot for it in the Processor PCA.

8. Go to paragraph 6.48 MONOCHROME GRAPHIC VIDEO or 6.49 COLOR GRAPHIC VIDEO Replacement Procedure which ever your TPU contains. Follow these directions for replacement of the Graphic Video PCA.

9. Go to paragraph 6.47 POWER SUPPLY Replacement Procedure. Follow these directions for replacement of the Power Supply PCA.

10. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow these directions for replacement of the TPU Inner Module.

6.492 ON/OFF SWITCH

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. Table Top Static Mat

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow those directions for removal of the TPU Inner Module.

2. Position the TPU Inner Module on its bottom with the rear panel away from the repair person. Be sure the power cord is unplugged from the TPU Inner Module.

3. Unplug P1 on the Power Supply PCA which is a two pin plastic connector.

4. Unplug the blue wire going to pin N on the Filter/Power Receptacle.

5. Unplug the brown wire goning to pin L on the Filter/Power Receptacle.

6. Unscrew the two screws securing the on/off switch with a #2 pozidriv.

7. Remove the on/off switch push rod by holding the push rod with one hand and the on/off switch arm with the other hand and pulling the two apart.

**** Replacement Procedure**

1. Position the TPU Inner Module with the rear panel away from the repair person. Be sure the power cord is removed from the TPU Inner Module.

2. Replace the on/off switch and insert the two screws that hold the switch to the TPU Inner Module

3. Plug in P1 on the Power Supply which is a two pin plastic connector, such that the brown wire corresponds pin L and the blue wire corresponds to pin N.

4. Plug in the blue wire to pin N on the Filter/Power Receptacle.

5. Plug in the brown wire to pin L on the Filter/Power Receptacle.

6. Snap on the extension arm to the on/off switch while guiding the front edge of the extension arm into the Processor PCA slot.

7. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow these directions for replacement of the TPU Inner Module.

6.493 FILTER/POWER RECEPTACLE

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. 3mm Nut Driver
3. 4mm Nut Driver
4. Table Top Static Mat

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow those directions for the removal of the TPU Inner Module.

2. Position the TPU Inner Module on its bottom with the rear panel away from the repair person. Be sure that the power cord is unplugged from the TPU Inner Module.

3. Using the 4mm nut driver remove the nut and two star washers securing the green and yellow striped ground wire to the back panel.

4. Unplug the blue wire from pin N on the power receptacle.

5. Unplug the brown wire from pin L on the power receptacle.

6. Using the #2 pozidriv and the 3mm nut driver remove the two bolts, two washers, three star washers and ground cable holding the Filter/Power Receptacle to the back panel.

**** Replacement Procedure**

1. Replace the Filter/Power Receptacle on the back panel. Secure the two screws, two nuts, three star washers and ground cable to the back panel using the #2 posidrive and the 3mm nut driver. This ground cable plugs onto the power supply.

2. Fasten the green/yellow ground wire to the back panel using a 4mm nut and two star washers with the 4mm nut driver. This ground wire is soldered to pin G of the filter/power receptacle.

3. Plug in the blue wire to pin N on the Power Receptacle.

4. Plug in the brown wire to pin L on the Power Receptacle.

5. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow those directions for replacement of the TPU Inner Module.

6.494 115v/230v SWITCH

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. 3mm Nut Driver
3. Table Top Static Mat

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow those directions for the removal of the TPU Inner Module.

2. Position the TPU Inner Module on its bottom with the rear panel away from the repair person. Be sure the power cord is unplugged from the TPU Inner Module.

3. Unplug the two wires connecting the 115v/230v switch to the Power Supply.

4. Using the 3mm nut driver, remove the two nuts and washers securing the 115v/230v switch to the back panel.

**** Replacement Procedure**

1. Be sure the power cord is unplugged from the TPU Inner Module.

2. Place the 115v/230v Switch to the back panel. Secure the two nuts and two washers using the 3mm nut driver. Be sure the printing is right side up and can be read from the back panel.

3. Plug in the two wires to the two posts on the Power Supply, they are interchangeable.

4. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow those directions for replacement of the TPU Inner Module.

6.495 CARD CAGE

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. 9/16 Wrench
3. 4mm Nut Driver
4. Table Top Static Mat

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow these directions for removal of the TPU Inner Module.

2. Go to paragraph 6.47 POWER SUPPLY Removal Procedure. Follow these directions for removal of the POWER SUPPLY.

3. Go to paragraph 6.48 MONOCHROME GRAPHIC VIDEO or 6.49 COLOR GRAPHIC VIDEO Removal Procedure whichever module your TPU contains. Follow these directions for removal of the Graphic Video PCA.

4. Go to paragraph 6.491 PROCESSOR Removal Procedure. Follow these directions for removal of the PROCESSOR.

5. Go to paragraph 6.492 ON/OFF SWITCH Removal Procedure. Follow these directions for removal of the Power Switch.

6. Using a 4mm Nut Driver remove the two nuts and washers securing the Card Cage to the back panel.

**** Replacement Procedure**

1. Replace the Card Cage on the back panel and secure the two 4mm nuts and washers that hold the two parts together.

2. Go to paragraph 6.492 ON/OFF SWITCH Replacement procedure. Follow these directions for replacement of the on/off switch.

3. Go to paragraph 6.491 PROCESSOR Replacement Procedure. Follow those directions for replacement of the Processor.

4. Go to paragraph 6.48 MONOCHROME GRAPHIC VIDEO or 6.49 COLOR GRAPHIC VIDEO Replacement Procedure whichever your TPU contains. Follow these directions for replacement of the Graphic Video PCA.

5. Go to paragraph 6.47 POWER SUPPLY Replacement Procedure. Follow these directions for replacement of the Power Supply PCA.

6. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow these directions for replacement of the TPU Inner Module.

6.496 BACK PANEL

**** Required Tools**

1. #2 Pozidriv (Screwdriver)
2. 9/16 Wrench
3. Table Top Static Mat
4. 3mm Nut Driver
5. 4mm Nut Driver

**** Removal Procedure**

1. Go to paragraph 6.46 TPU INNER MODULE Removal Procedure. Follow these directions for removal of the TPU Inner Module.

2. Go to paragraph 6.47 POWER SUPPLY Removal Procedure. Follow these directions for removal of the POWER SUPPLY.

3. Go to paragraph 6.48 MONOCHROME GRAPHIC VIDEO or 6.49 COLOR GRAPHIC VIDEO Removal Procedure whichever your TPU contains. Follow these directions for removal of the Video PCA.

4. Using a 4mm nut driver remove the two nuts and washers that secure the card cage to the back panel.

5. Go to paragraph 6.495 POWER/FILTER RECEPTACLE Removal Procedure. Follow those directions for removal of the Filter/Power Receptacle.

6. Go to paragraph 6.497 115/220 SWITCH Removal Procedure. Follow those directions for removal of the 115/220 Switch.

**** Replacement Procedure**

1. Go to paragraph 6.497 115/230 SWITCH Replacement Procedure. Follow those directions for replacement of the 115/220 Switch to the back panel.

2. Go to paragraph 6.495 FILTER/POWER RECEPTACLE Replacement Procedure. Follow these directions for replacement of the Power Receptacle to the back panel.

3. Position the Card Cage on the Back Panel and secure with two 4mm nuts and washers using the 4mm nut driver. Be sure to align the front edge of the Processor PCA in between the tabs on the back panel.

4. Go to paragraph 6.48 MONOCHROME GRAPHIC VIDEO or 6.49 COLOR GRAPHIC VIDEO Replacement Procedure. which ever your TPU contains. Follow these directions for replacement of the Graphic Video.

5. Go to paragraph 6.47 POWER SUPPLY Replacement Procedure. Follow these directions for replacement of the Power Supply.

6. Go to paragraph 6.46 TPU INNER MODULE Replacement Procedure. Follow these directions for replacement of the TPU Inner Module.

6.497 FRONT BEZEL

**** Required Tools**

1. Needle Nose Pliers

NOTE. When the Front Bezel is removed the five tubular fasteners will be damaged. If the Logo is removed from the Front Bezel, it will be damaged. So when replacing the Front Bezel always order the Logo and five tubular fasteners with the Front Bezel.

**** Removal Procedure**

1. Grasp the sides of the Front Bezel with your hands and pry it off.

2. Remove any tubular fasteners that remain in the holes of the TPU.

**** Replacement Procedure**

1. Place the five tubular fasteners into the five holes in the front side of the TPU metal box. They should be orientated such that the flanged head is outside the box.

2. Replace the Front Bezel by fitting the five plastic posts into the five tubular fasteners in the TPU box. Be sure the Front Bezel is properly aligned with the power button.

3. Push the Front Bezel into place.

6.50 ASSEMBLY IDENTIFICATION

Each printed circuit assembly (PCA) has part number, rev code, date code and manufacturing division etched on it. The Hewlett-Packard logo is also etched in this same area on the PCA. An example of this numbering is;

[(hp)]
40210-60001
A-2420-63

[(hp)] = This is the Hewlett-Packard Co. logo.

40210-60001 = This is the PCA part number. It is either an eight or ten digit number.

A = This is the revision number of the PCA. Each time the art work for the raw board is modified, the revision number is changed. For example the next change to the raw board would be denoted by changing the revision number to B.

2420 = This is the date code of the last change to the PCA. The first and second digits denote the year, if 60 is added to that number. In our example 24 + 60 = 84. Thus, 1984 was the year of the latest change to this PCA. The third and fourth digits denotes the number of the week of the latest change to this PCA. This PCA was changed in the twentieth week.

63 = This two digit number denotes the number of the division that manfactured this part.

SECTION 7

ADJUSTMENTS

7.00 INTRODUCTION

There are no adjustments necessary for operation and repair of the TPU. However the TPU is used in conjuction with a monitor. Monitor adjustments are usually necessary for normal operation of the terminal. A Display Adjustment test pattern is provided under self-tests for raster and touchscreen alignment on a monitor. Also included at the end of a Terminal Test or Manufacturing Test is an alpha test pattern for checking the video display on a monitor. There are also three test patterns included at the start of the Manfacturing Test that also can be used to align the display of a monitor. For the color TPU or 2397A color terminal, the alpha test pattern at the end of the Terminal Test or Manfacturing Test is in color. Two of the three test patterns at the start of the Manfacturing Test are color graphic test patterns.

NOTE

To align a monitor see the service manual for that respective monitor.

SECTION 8

TROUBLESHOOTING and DIAGNOSTICS

8.00 INTRODUCTION

This section covers problem solving, fault isolation, repair and troubleshooting. All these terms refer to methods that are used to fix electronic equipment when that equipment is not operating correctly.

The most important tool used to troubleshoot terminals is the internal self-test. There are several varieties of self-tests included in the TPU feature set which make problem isolation much more accurate and efficient. The capabilities of each test are explained in detail as well as the error codes. These self-tests are designed to help the repair person analyze failures to the module and in some instances the component level. There is a discussion on logical troubleshooting and some general hints on fault isolation also included in this section.

8.10 SAFETY CONSIDERATIONS

WARNING

Hazardous voltages are present inside the TPU. Injury or death may result if discharge occurs to an unprotected person. Always turn off power to the TPU and remove the power cord from the TPU when taking it apart. There are exposed line voltages of 115 or 230 volts AC inside the TPU. Removal and replacement procedures are located in section 6 and should be performed by a qualified service person.

CAUTION

When replacing a defective module it is important to turn off the power to the TPU and remove the line cord to the TPU. This will prevent damage to the TPU or replacement module. When an electrical PCA is plugged into or removed from a live circuit there is always a chance that the module or the circuit will be damaged.

When the TPU is disassembled it is extremely vulnerable to ESD. Also the electrical modules or PCAs used for repair are vulnerable to ESD. Use proper ESD procedures when opening the TPU and handling any of the TPU modules or components.

8.20 TROUBLESHOOTING STRATEGY

The strategy for troubleshooting the 2393A and 2397A graphic terminals is to identify a defective module or assembly using the internal self-tests. There are several internal self-tests to help in the troubleshooting process. These self-tests are documented in section 8.50 Self-Test Operating Proceedures.

It is recommended to the repair person to use a systematic approach for troubleshooting the 2393A and 2397A terminals as taught in the "Problem Solving Pre-study" course, HP part number 2393A+49A-90101. When a difficult problem is encountered the repair person can reference section 8.40 Troubleshooting Procedures for suggestions on problem analysis.

When troubleshooting, the repair person should;

a. Solve one problem at a time.
b. Write the problem down.
c. Analyze the problem. (self-tests)
d. Specify the cause.
e. Verify the cause.
f. Decide on a course of action for repair.
f. Think beyond the repair, will it happen again?

8.30 MINIMUM CONFIGURATION

The minimum configuration consists of the smallest number of modules to make up a terminal. This is a troubleshooting aid when the terminal becomes difficult to repair. The idea is to remove unnecessary modules, input devices, and peripherals that might be contributing, confusing or causing a problem. For example when a terminal failure is suspected, one of the first steps is to disconnect the terminal from the CPU. This process will simplify the terminal failure analysis.

The minimum configuration for a terminal can be reached by following the procedure listed below;

1. Disconnect the TPU from the CPU by unplugging the cable at the rear panel of the TPU that connects to the CPU.

2. Disconnect the external device or devices that are connected to the TPU.

3. Remove the optional I/O module from the TPU by following the removal procedures in section 6 for the accessory module.

4. Remove all the input devices except the keyboard. To do this, follow the removal procedures in section 6, under keyboard and HP-HIL devices.

5. Check to be sure that only one monitor is used. If more than one monitor is used, disconnect the additional monitors following the monitor removal procedures in section 6.

This is the terminal's minimum configuration which consists of one TPU, one monitor and the keyboard as the only HP-HIL input device. The terminal is disconnected from the CPU and the auxiliary I/O module has been removed from the TPU.

8.40 TROUBLESHOOTING PROCEDURES

This section gives some suggestions for identifying terminal problems and then finding the cause. Terminal troubleshooting usually starts with the terminal as either stand-alone or configured to a combination of input devices / output devices / computer. A stand-alone terminal can be much simpler to troubleshoot than one configured to a computer and other devices.

8.41 SYMPTOMS

Symptoms 1 through 4 listed below refer to a stand-alone or minimum configured terminal. Section 8.30 Minimum Configuration lists the steps necessary to configure a terminal to its minimum configuration.

Symptoms 5 through 7 listed below refer to a terminal that is configured to a combination of input devices / output devices / computer.

1. ERROR MESSAGE

When an error message occurs, write it down and then determine what type of error message it is and what it means. Error message types are listed below;

A. Terminal Operation Error

These errors are generated by a user making a mistake operating the terminal. These errors are listed in the reference manual and they do not indicate a hardware failure.

B. Terminal Self-Test Error

These errors are generated by a self-test detecting a hardware failure and they are listed in section 8.60 Self-Test Error Codes. Check that the error is repeatable after powering off and on the terminal. If the error is repeatable then the defective module indicated by the error message should be replaced. If the error message is not repeatable then refer to Intermittent Operation symptom.

2. IMPROPER DISPLAY

Display problems are broken down into two different types, display quality and display content.

A. Display Quality is the presentation of data on the monitor. Examples of display quality problems are distorted characters, jittery display, wavy rows of characters, focus problems, centering problems, partial characters, graphic line distortions, incorrect colors, etc. This problem can be analyzed by doing a Terminal Test and analyzing the self-test pattern on the terminal monitor. Causes of this problem could be;

a. Monitor adjustments needed.
b. Defective Monitor.
c. Defective Graphic Video PCA.
d. Defective Video Cable between the TPU and Monitor.
e. Defective Processor PCA.

B. Display Content is incorrect data being displayed on the Monitor. An example of this is typing the E key on the keyboard and an O apearing on the display. Other examples are null characters covering the display, random characters appearing on the display, garbled text, graphic vectors appearing randomly, etc. Causes of this symptom could be;

a. Processor PCA
b. Graphic Video PCA
c. ROM PCA
d. Keyboard
e. Keyboard Cable
f. Power Supply

3. NO DISPLAY

For this symptom the display is totally blank. No characters, cursors, or graphic data is visible. Possible causes for this symptom could be;

a. Brightness and contrast not adjusted properly.
b. Defective Monitor.
c. Defective Video cable to Monitor from TPU.
d. Defective TPU

If a defective TPU is suspected, further analysis must be performed to determine which PCA module is at fault. To do this an OFF/ON Test can be initiated. A bell will sound as soon as the TPU is turned on and another will sound five seconds later to signify the successful completion of the self-test. If the OFF/ON Self-Test is ok then suspect the:

a. Graphic Video PCA

If the OFF/ON Test fails then the Test Module can be used as described in section 5.24 to check the power supply voltages. If the power supply voltages are not correct, the following are possible causes:

a. Power Supply PCA
b. Power Switch
c. 8 pin Ribbon Cable
d. Processor PCA
e. ROM PCA
f. Graphic Video PCA
g. Receptacle/Filter Assembly

If the power supply voltages are correct then the Test Module Test can be run as defined in section 8.50. If this test fails the possible causes could be:

a. Processor PCA
b. ROM PCA
c. Graphic Video PCA.

4. INTERMITTENT OPERATION

Problem occurs once a week, once a day or every few hours. It is difficult for a repair person to duplicate this type of failure given the time constraints. For this type of problem it is important to carefully specify the trouble symptoms since they happen so seldom.

The Manufacturing Test can aid the repair person to reproduce this type of failure. This test will run continuously until an error is detected or the test is stopped.

5. INPUT DEVICES / HP-HIL DEVICES

Several devices can now hang off the keyboard interface. An indication of an HP-HIL device failing will be an HP-HIL error, the device not working or the device working improperly. The trouble shooting strategy would be to initiate the Power On Test which will test the HP-HIL Loop for defective devices. This will report failing HP-HIL devices.

If that doesn't work, input devices can be swapped out one at a time until the failing device is found. Other possible causes could be:

a. HP-HIL Cable
b. Damaged HP-HIL Connector
c. Cable Connector forced into wrong receptacle.
d. Processor PCA.

6. PERIPHERAL CONNECTION

A peripheral is usually connected to port one or two on the TPU. If a connection to a peripheral is not working then a Datacomm Self-Test can be performed on that port. This test will work for the RS-232 I/O and the HP-IB I/O but not for the Parallel I/O on port 2. Possible causes for this symptom are:

a. External Device Configuration
b. Cable between TPU and External Device.
c. Auxiliary I/O Module (port 2)
d. Bent pins on connector I/O Module plugs into.
e. Processor PCA
f. External Device.

7. COMPUTER CONNECTION

A computer can be connected to either port one or two on the TPU. If this connection does not work, then a DataComm Self-Test can performed on the port that is not working. Possible causes for this symptom are:

a. Terminal Configuration
b. System Configuration
c. Cable between system and terminal.
d. I/O module (port 2)
e. Processor PCA

8.50 SELF-TEST OPERATION

The following are self-tests available on the 2393A and 2397A:

OFF / ON TEST

POWER ON TEST

TERMINAL TEST

DATACOMM TEST

IDENTIFY HARDWARE

DISPLAY ALIGNMENT

MANFACTURING TEST

TEST MODULE TEST

These self-tests are built into the terminal's firmware to aid the repair person when discovering, analyzing, and verifying terminal failures. The tests are provided to minimize terminal down time and to help isolate failures to a defective module or assembly.

Description, initiation procedure, and results sections have been provided to describe and identify each self-test. Each test has been divided into sub tests to give the repair person an idea of what is being tested by each test.

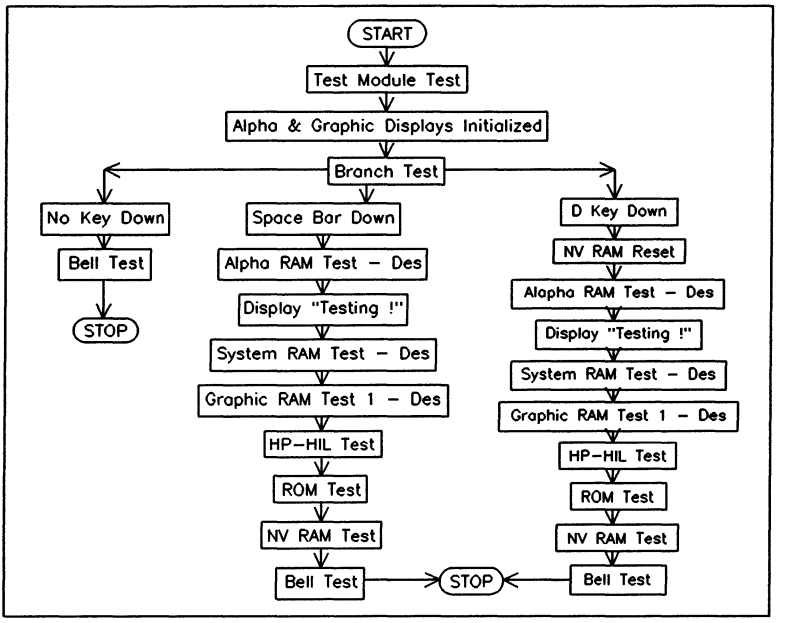

Figure 8-51 OFF / ON Test Flow Chart

8.51 OFF / ON TEST

This self-test is executed by powering on the TPU. Its purpose is to verify that the terminal is in good operating condition before the operator starts using the terminal for normal business. This test should find a malfunction before the operator does accidently. It consists of a series of sub-tests which are executed in order. If the test detects an error it will stop at that test and report the error. Only one error at a time will be detected. By depressing a key on the keyboard while turning on the TPU either of two different branch tests can be entered.

Execution Time

2393A = 5 sec.
D key branch = 28 sec.
Space Bar key branch = 25 sec.

2397A = 5 sec.
D key branch = 35 sec.
Space Bar key branch = 38 sec.

Initiation

There is one way to start this test:

1. Power on the TPU

There are three versions of this test. Once the Off / On test has been initiated it reaches a point where it will branch in three different directions. This branching is controlled by the repair person by holding down the proper key on the keyboard. The three different branches and how to execute them are listed below:

Basic - Off / On Test, (No Key Depressed)

This is the basic test and if nothing is done after initiating the Off / On test, this version will execute.

[Space Bar] Key Branch - Off / On Test

This is a longer version of the basic test that adds a ROM test, RAM tests and HP-HIL test. It is triggered by holding down the space bar on the keyboard before the Off / On test has been initiated and keeping it depressed until the word "Testing !" appears on the 25th line of the display.

[D] Key Branch - Off / On Test

This version resets the NONVOLATILE memory back to its default state as well as executing the Extended Off / On test. It is triggered by holding down the [D] key on the keyboard before the Off / On test has been initiated and keeping it depressed until the word "Testing !" appears on the 25th line of the display.

Results

Successful Self-Test Completion

After a successful Off / On Test, the terminal will display the soft key labels and a blinking cursor in the upper left hand corner of the display.

Error Dection

After an error has been detected it will be displayed on the 25th line which is the error message window. Error messages are defined in section 8.60 SELF-TEST ERROR CODES. There is a low probability that the terminal might not be capable of displaying an error message. If this is the case other steps must be taken to find the cause of failure.

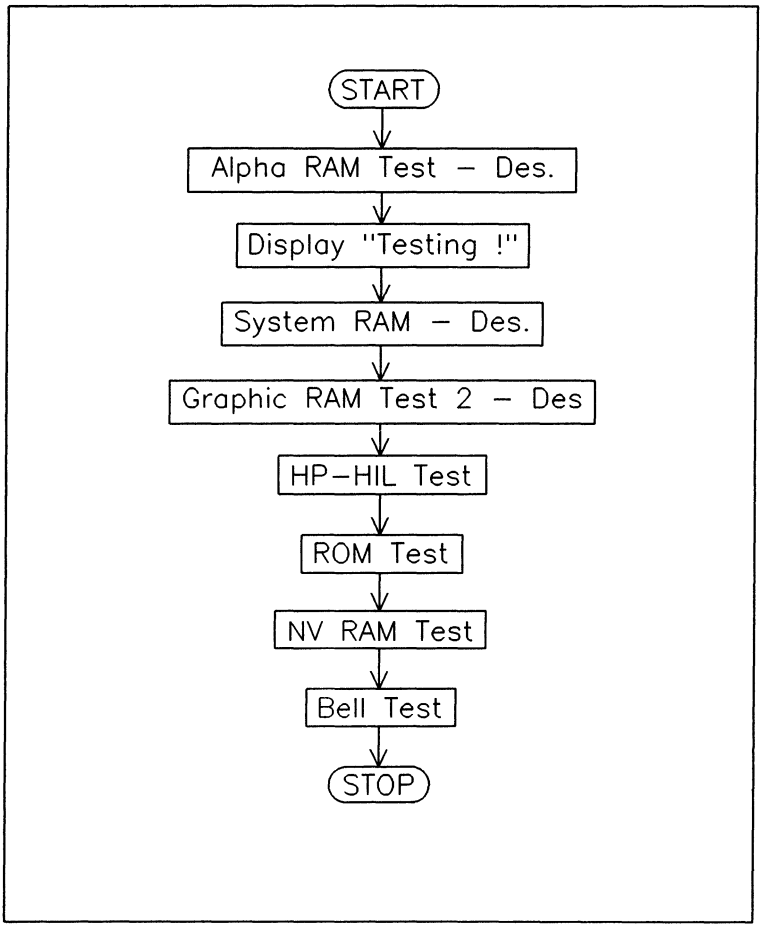

Figure 8-52 Power On Test Flow Chart

8.52 POWER ON TEST

This self-test is executed by pressing the [Power On Test] Key. It does an extensive destructive test on TPU RAM memory. It consists of a series of sub-tests which are executed in order. If the test detects an error it will stop at that test and report the error. Only one error at a time will be detected.

Execution Time

2393A = 25 sec.
2397A = 35 sec.

Initiation

There is one way to start this test:

1. A. Press the [User/System] key,

   B. Then press the [f3] function key under the [service keys] label.

   C. Then press the [f1] function key under the [Power On Test] label.

Results

Successful Self-Test Completion

After a successful Power On Test, the terminal will display the soft key labels and a blinking cursor in the upper left hand corner of the display.

Error Detection

After an error has been detected it will be displayed on the 25th line which is the error message window. Error messages are defined in section 8.60 SELF-TEST ERROR CODES. There is a low probability that the terminal might not be capable of displaying an error message. If this is the case other steps must be taken to find the cause of failure.

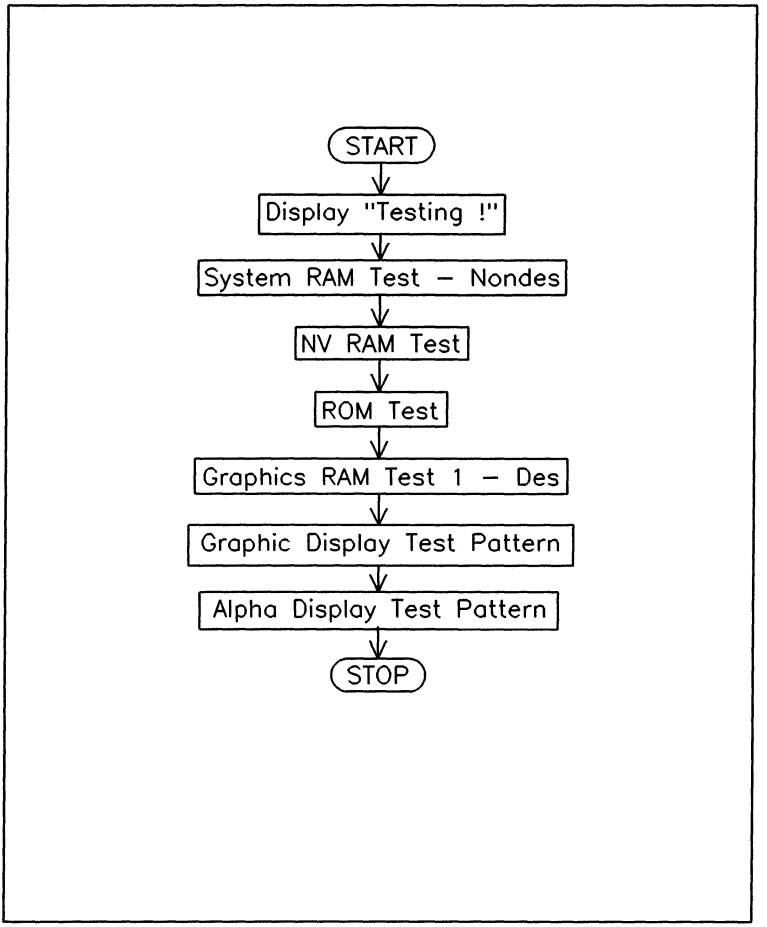

Figure 8-53 Terminal Test Flow Chart

8.53 TERMINAL TEST

This self-test is designed for the operator to check the terminal's operation. It is non-destructive, so the user can initiate it without disturbing the terminal's configuration or alpha memory. However it does a destructive test of the graphics memory. It also displays on the monitor a graphic test pattern and an alpha test pattern so the monitor display can be checked, adjusted or aligned. If the test detects an error it will stop at that test and report the error. Only one error at a time will be reported.

Execution Time

2393A = 20 sec.
2397A = 50 sec.

Initiation

There are three ways to start this test and they are listed below:

1. A. Press the [User/System] key,

   B. Then press the [f3] function key under the [service keys] label.

   C. Then press the [f5] function key under the [Terminal Test] label.

2. Send the terminal an ESC z remotely.

3. Type on the terminal keyboard [ESC] z.

Results

Successful Self-Test Completion

After a the test is successfully completed an alpha test pattern will be displayed. This pattern will consist of all character sets that are resident in the terminal.

Error Detection

After an error has been detected it will be displayed on the 25th line which is the error message window. Error messages are defined in section 8.60 SELF-TEST ERROR CODES. There is a low probability that the terminal might not be capable of displaying an error message. If this is the case other steps must be taken to find the cause of failure.

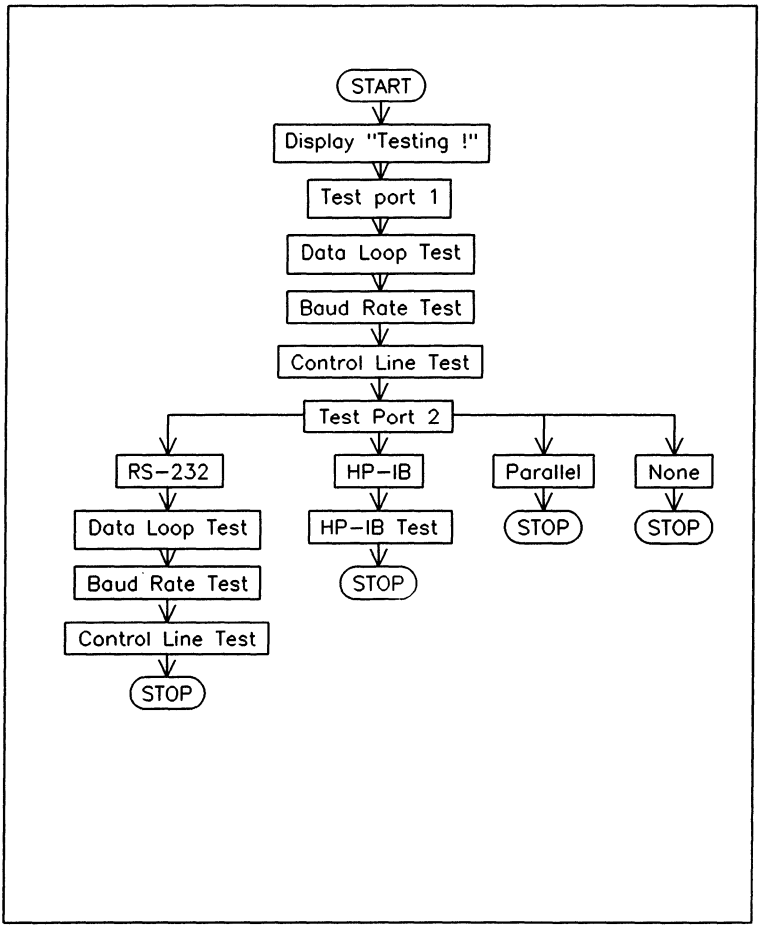

Figure 8-54 Data Comm Test Flow Chart

8.54 DATACOMM TEST

This test loops data and control line signals for each RS-232 port. It is used in conjunction with a self-test hood that physically loops the transmit line to the receive line and also loops the output signal lines to the input signal lines. This test will first test Port 1, then it will test Port 2 if there is an RS-232 Module or HP-IB Module Installed.

Execution Time

2393A = 5 to 8 sec. (depending on baud rate selected)
2397A = 5 to 8 sec. (depending on baud rate selected)

Initiation

There is one way to start this test and it is listed below:

1. A. Put self-test hood, (02620-60062) on Port 1.

   B. If Port 2 has an RS-232 I/O module, put another self-test hood, (02620-60062) on Port 2.

   C. Press the [User/System] key,

   D. Then press the [f3] function key under the [service keys] label.

   E. Then press the [f7] function key under the [Datacomm Test] label.

NOTE: Other datacomm self-test hoods will work with this test. To test the HP-422 drivers and recievers on port 1 use self-test hood (5061-3248). To test a cable and the terminal port use RS-232 self-test hood (02645-60004).

Results

Successful Self-Test Completion

A normal display is restored with the soft key labels on rows 25 and 26 and a blinking cursor in the upper left hand corner. This is a non-destructive test and display memory is not changed.

Error Detection

After an error has been detected it will be displayed on the 25th line which is the error message window. Error messages are defined in section 8.60 SELF-TEST ERROR CODES.

8.55 IDENTIFY HARDWARE

This is not a test. It identifies the part number of the firmware ROMs and their revision level. It also displays the size of the display memory and which video PCA is installed. This check allows the repair person to get this information without physically disassembling the TPU.

Execution Time

2393A = Instantaneous
2397A = Instantaneous

Initiation

There is one way to start this test:

1. A. Press the [User/System] key,

   B. Then press the [f3] function key under the [service keys] label.

   C. Then press the [f6] function key under the [Identify ROMs] label.

Results

There are no error codes associated with this test.
The results of this test is a list of the Firmware ROMs and there revision levels. Below is an example of what might appear;

```
 Firmware IDs
==============
1818-3709  2523
1818-3710  2523
1818-3711  2523
1818-3712  2523
1818-3713  2523
1818-3714  2523
1818-3715  2523
1818-3546  2523  *1
```

RAM Installed: Y
Graphic Hardware Installed: Z

where Y =
64k - 12 pages of Display Memory.

where Z =
Color - Color Video PCA is Installed.
Monochrome - Monochrome Video PCA is Installed.

Note *1 = This ROM is located on the HP-IB Module and it is listed only if the HP-IB auxiliary module is installed.

8.56 DISPLAY ALIGNMENT

The Display Alignment is a graphic display pattern that is used for touch screen alignment on a Monitor. It also can be used for raster adjustments on a Monitor. If adjustments are to be made, see Section 7, ADJUSTMENTS.

Execution Time

2393A = Instantaneous
2397A = Instantaneous

Initiation

There is one way to start this test:

1. A. Press the [User/System] key.

   B. Press the [f3] function key under the [service keys] label.

   C. Press the [f4] function key under the [DISPLAY ALIGNMNT] label.

To cancel this graphic display, do either of the following listed below:

1. Press the [CTRL] and [CLEAR DISPLAY] keys.

or

2. A. Press and hold down the [CTRL] key and then the press the [-] key on the numeric pad. This will change the numeric pad to a graphic pad. It also will change the graphic pad back to a numeric pad.

   B. Now press the [Clear Graphic Display] key.

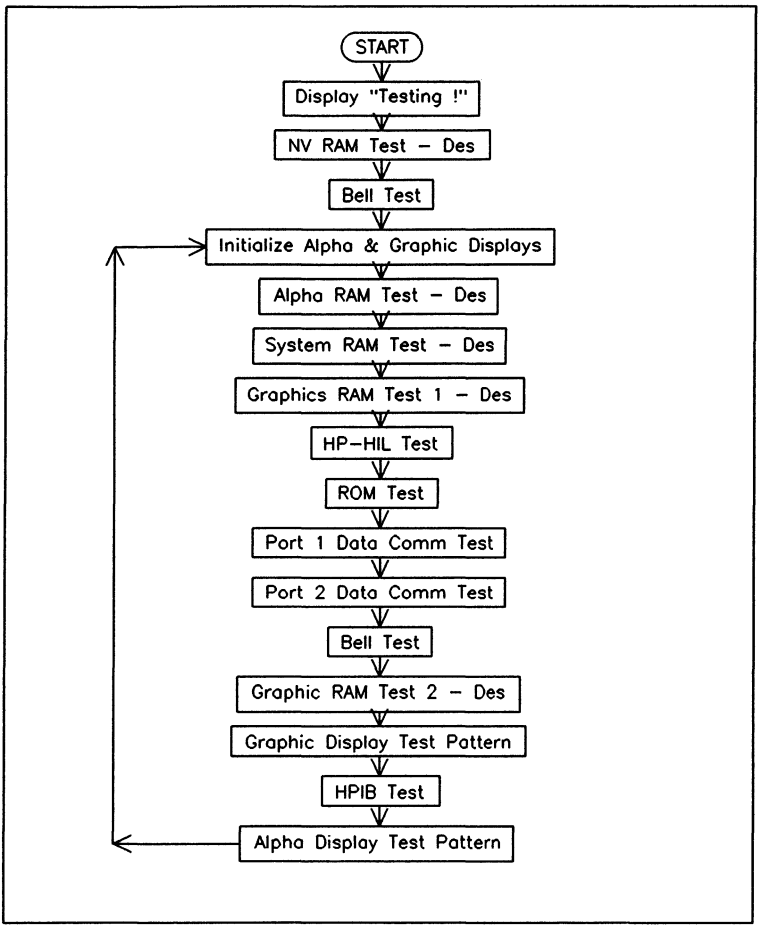

Figure 8-55 Manufacturing Test Flow Chart

8.57 MANUFACTURING TEST

This test is the most comprehensive of all terminal self-tests. It is a combination of the Power On Test, Data Comm Test and more. It has the ability to repeat again and again. This test is helpful for finding intermittent failures. Once a failure is found it will be stored in non-volatile RAM and displayed on the monitor. This test will cycle indefinitely until it is stopped.

Initiation

There is one way to start this test and it is listed below:

1. A. Put a self-test hood on port 1, (02620-60062).

   B. If port 2 I/O module is an RS-232 option put a self-test hood on it, (0260-60062) or remove it from the TPU.

   C. Press and hold the following 4 keys in sequential order; [CTRL], Left [Shift], Right [Shift], [Print]/[Enter].

A raster full of @s will appear on the monitor display.

   D. Press [Return]
A raster with every other vertical column of graphic dots turned on will appear on the monitor.
For the 2397A the raster will also be divided into four equal columns of color; red, green, blue and white.

   E. Press [Return]
A raster with every graphic dot turned on will appear on the monitor.
For the 2397A the raster will also be divided into four equal columns of color; red, green, blue and white.

   F. Press [Return]
Now the Manufacturing Test will begin to cycle. It will cycle until it is halted or an error is found.

NOTE 1. To halt this test it will be necessary to perform a hard reset. Press and hold the following 3 keys in sequential order; [CTRL],[Shift] and [Reset] keys.

NOTE 2. It might take a couple of hard resets before the terminal detects that the keys are being depressed.
During certain subtests the processor does not look at inputs from the keyboard.

NOTE 3. After the Manufacturing Test stops, there could be an error message on the display. This error message is stored in non-volatile memory and must be cleared from EEPROM before normal terminal operation will resume.

To clear the error message and exit Manufacturing Test do a hard reset by pressing the [CTRL],[SHIFT],[RESET] keys.

You can also clear the error message and exit Manufacturing Test by powering off the TPU and holding down the [D] key, then powering on the TPU. The [D] key can be released when the "Testing !" message is displayed.

NOTE 4. At least one HP-HIL device must be connected to the TPU to run this test.

Results

Successful Self-Test

When this test is successful it will continue until stopped with a hard reset.

Error Detection

When an error is discovered the Manufacturing Test is stopped and an error message is displayed on the 25th line of the monitor. Error messages are defined in section 8.60 SELF-TEST ERROR CODES. The error message is stored in non-volatile memory and must be cleared from EEPROM before normal terminal operation can resume. To clear the error message and end the Manufacturing Test a hard reset must be performed. To do a hard reset and press simultaneously the following keys [CTRL], [SHIFT] & [RESET].

A second way to clear the error message and end the Manufacturing Test is to hold down the [D] key, then power off/on the TPU. The [D] key can be released when the ". Testing ! " message is displayed in the error message window.

There is a low probability that the terminal might not be able to display an error message. If this is the case other steps must be taken to find the cause of failure.

Execution Time

2393A
1st Cycle = 80 sec.
2nd or greater cycle = 40 sec.

2397A
1st Cycle = 120 sec.
2nd or greater cycle = 80 sec.

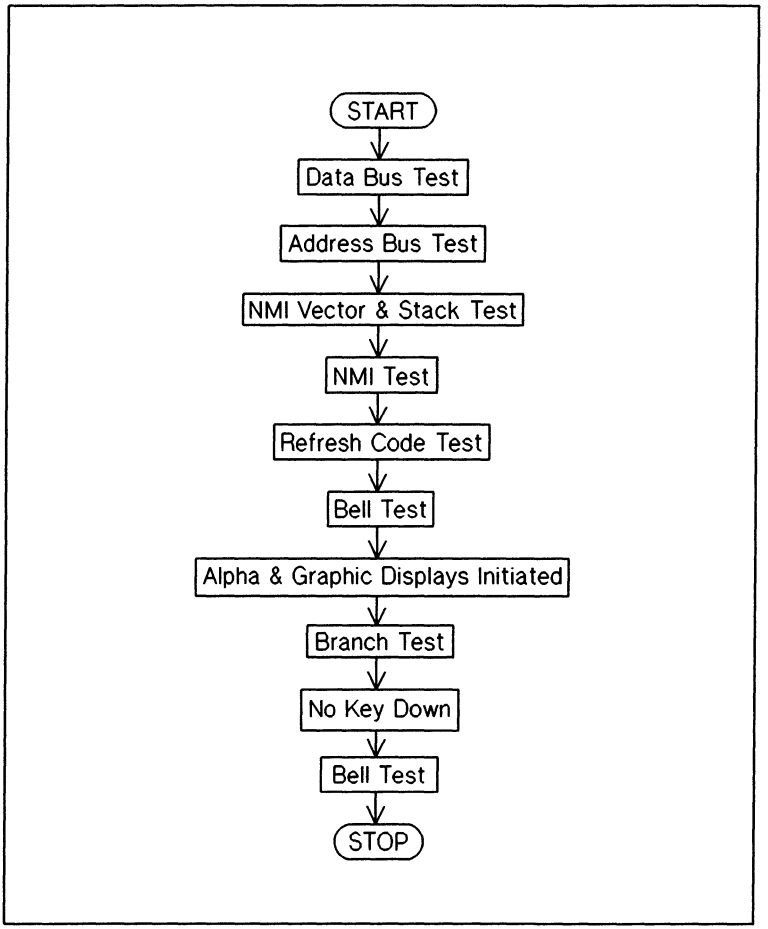

Figure 8-56 Test Module Test Flow Chart

8.58 TEST MODULE TEST

The Test Module, part number 02390-60010, can be used in conjunction with the OFF/ON Test. It is plugged into port 2, the extended I/O Data Comm Port. There are several LEDs on this module that are used to report error conditions in place of the display. There are also test points for the power supply voltages. In this manner, power supply voltages can be monitored without opening the TPU. There are LEDs that represent each of the power supply voltages. When lighted, they indicate that those voltages are present.

Initiation

There is one way to start this test:

1. A. With the power off install the Test Module, 02390-60010, in the extended I/O port.

   B. The position of the switch on the Test Module can be in any position.

   C. Power on the TPU.

Results

Successful Self-test Completion

A successful test will result in LEDs lighted and the bell beeped. See section 8.60 SELF-TEST ERROR CODES for the LED meanings.

Error Detection

If an error condition exists LEDs will be lighted. See section 8.60 SELF-TEST ERROR CODES for the LED meanings.

Execution Time

2393A = 1 sec.
2397A = 1 sec.

8.59 SUB TEST DESCRIPTIONS

This section describes what happens during each individual test.

Bell Test = The bell is beeped for a brief period. The test fails if the bell is not heard.

Display "Testing !" = The word "Testing !" is displayed on the monitor display on line 25.

Branch Test = This test looks for a key depressed on the keyboard. Only the [D] and [SPACE BAR] keys have special meanings. Each of these keys will send the test program into a different branch of the self-test.

HP-HIL Test = The HP-HIL Loop is checked for the presence of devices, their self-tests are initiated, and the resultant status is checked. The test fails if the status of any device indicates a failure.

NV RAM Test = A cyclic redundancy check (CRC) character is generated for the NV RAM. The test fails if the CRC character is not zero.

NV RAM Test = This is a destructive RAM test. It performs a (Destructive) marching ones and zeros test in NV RAM. It writes all ones to memory, then reads and verifies the data. Next it writes zeros to memory, then reads and verifies the data. The test fails if a byte read is not the one written.

NV RAM Reset = The nonvolatile RAM is reset to its original or default state and CRC character is compared.

ROM Test = A CRC character is generated for each ROM. One test result is generated for each ROM. The test fails if any of the CRCs are not zero. This test also checks that the ROMs are in the proper position for their address and that they are correct. The 7 main code ROMs (located on the ROM Module) are checked and the Auxiliary ROM is checked (if there is an Auxiliary Module installed in Port 1 and if there is an Auxiliary ROM installed on the Auxiliary Module. The HP-IB Auxiliary Module has a ROM installed on it.)

System RAM Test (Destructive) = This is a destructive test of the system RAM. It does a marching ones and zeros test of the system RAM. The test fails if each byte read from RAM is not the same as that written.

System RAM (NonDestructive) = This is a nondestructive test of system RAM. It reads the system RAM memory, inverts it, then writes it back into memory. Next it reads the system RAM, verifies it, then inverts it, then writes it back into system RAM. The test fails if bytes read are not the same as those written.

Alpha RAM Test (Destructive) = This is a destructive test that does a traveling ones and zeros test first. Then it does a marching ones and zeros test. If a bit fails the error is reported to the display.

Graphics RAM Test 1 (Destructive) = This is a destructive RAM test. It writes zeros to all graphics planes, then reads and verifys the data. Next it writes ones to the graphic planes, then reads and verifys the data. This test fails if any byte read from RAM is not identical to the one written. This is a marching ones and zeros test.

Graphics RAM Test 2 (Destructive) = This is a destructive RAM test. It sets all graphic planes to one, then checks that all bytes are set to one. Next it sets all graphic planes to zero and checks that all bytes are set to zero. This test fails when a byte read from RAM is not the same as written.

Graphics Display = This is a display pattern for the monitor.
Test Pattern The color version starts with four vertical bars; red, green, blue and white displayed with every other column of dots. Next the four vertical columns are displayed with all dots. Next a full display of white dots is displayed. Now 8 vertical columns of different colors are displayed. Next a full red display at 33% intensity, then 66% intensity, then 100% intensity is displayed. Now a green display steps through the three intensity levels and then a blue display steps through the three intensity levels. Next the eight color bars reappear. The color test appears when a color video PCA is in the TPU and a color monitor is used. If a monochrome monitor is connected to the TPU the different colors will appear as shades of gray.

The monochrome version starts with a full display with every other vertical column of dots turned on. Then a full display with every dot turned on is displayed. Then a full display is turned on briefly.

Alpha Display = This is a display pattern for the monitor.
Test Pattern It consists of several rows of alphanumeric characters with a terminal status at the bottom of the display. When a Color Video PCA is in the TPU the alpha display pattern is in eight different colors divided vertically.

DC Loop Test = This is a loopback test. It requires a loopback hood to loop the data from the datacomm drivers back to the receivers. This test fails if the recieved data is not the same as that transmitted. Data is sent at configured baud rate, parity and stop bits.

DC Control Test = This test requires a loopback hood. Several RS-232 control lines are looped to check their operation. The driver lines are looped to the recieve lines and then toggled at a 19.2 k baud rate.

Baud Rate Test = This test requires a loopback hood. Characters are looped backed at either a 110 or 150 baud rate and then a speed test is done to assure that they are at the proper rate. These baud rates are used since all other bauds are a multiple of either 110 or 150 baud.

Port 1 DC Test = This is the same test as the DATA COMM TEST. It is performed on port 1 as part of the MANUFACTURING TEST. A self-test hood must be plugged onto this port for this test.

Port 2 DC Test = This is the same test as the DATA COMM TEST. It is performed on port 2, the optional I/O port when it is installed with an RS-232 module. This is part of the MANUFACTURING TEST and the RS-232 module must be fitted with a self-test hood to pass this test.

HPIB Test = This test is performed as part of the MANUFACTURING TEST when an HPIB module is installed in port 2, the optional I/O port. This test checks the integrity of the HPIB controller IC located on the HPIB I/O Module.

8.60 SELF-TEST ERROR CODES

Error messages are displayed on lines 25 and 26 which are normally used to display function key labels. They are a result of a self-test detecting an error condition. Below is an explanation of those error codes.

8.61 ROM X Y

where X =	**where Y =**
0 = ROM 1	1 = Bad CRC
1 = ROM 2	2 = Wrong ROM in Socket
2 = ROM 3	3 = No ROM in Socket
3 = ROM 4	
4 = ROM 5	
5 = ROM 6	
6 = ROM 7	
7 = Aux ROM	

Meaning

ROM 1 through ROM 7 errors indicate that the following modules could be defective. They are listed in order with the highest probable failure as number one.

1. ROM Module
2. Bent pins on the connector that the ROM module plugs into.
3. Processor PCA

Aux ROM error indicates that the following modules could be defective. They are listed in order with the highest probable failure as number one. To date the only Auxiliary Module that has a ROM located on it is the HP-IB Module.

1. HP-IB Auxiliary Module
2. Bent pins on the connector that Auxiliary Modules plug into.

8.62 HP-HIL ERROR XX YY

where XX = HP-HIL Device Address

Device address 01 is closest to the TPU. Devices increase by one as they are connected farther away from the TPU. Devices are connected in series. When the device address is 00, it indicates that the HP-HIL Master Controller Chip is defective.

where YY =

00 = Data was sent to this device to activate the self-test but no result was returned.

01 or greater = An error condition exists in this device. For an explanation of this error code see the respective device error codes that failed.

Meaning

The above error codes indicate that the following modules could be defective. They are listed in order with the highest probable failure as number 1.

1. HP-HIL Cable
2. HP-HIL Device Specified
3. HP-HIL Connector
4. Processor PCA

8.63 RAM ERROR 11 222222 33/44/55

where 11 = Error codes as listed below

01 = Traveling ones test that failed on first try.
02 = Traveling ones test that failed on first try and passed on second try.
03 = Interference test that fails on first try.
04 = Interference test that fails on first try and passed on second try.
05 = Marching ones test that fails on first try.
06 = Marching ones test that fails on first try and passes on second try.
07 = Marching zeros test that fails on first try.
08 = Marching zeros test that fails on first try and passes on second try.

where 222222 = Physical address of failing byte

where 33 = Expected data

where 44 = Actual data read on first try

where 55 = Actual data read on second try

Meaning

The above error codes indicate that the following modules could be defective. They are listed in order with the highest probable failure number one. By decoding the RAM address the defective module can be pinpointed. The Memory Map is figure 5-07 and will aid in decoding the defective RAM address.

1. Processor PCA
2. Graphics PCA

8.64 NV RAM ERROR 11

where 11 = Error codes as listed below

01 = Traveling ones test that failed on first try.
02 = Traveling ones test that failed on first try and passed on second try.
03 = Interference test that fails on first try.
04 = Interference test that fails on first try and passed on second try.
05 = Marching ones test that fails on first try.
06 = Marching ones test that fails on first try and passes on second try.
07 = Marching zeros test that fails on first try.
08 = Marching zeros test that fails on first try and passes on second try.

Meaning

The above error codes indicate that the following modules could be defective. They are listed in order with the highest probable failure as number one.

1. Processor PCA

8.65 PORT X DC ERROR YY

where X =

1 = Port 1 Error
2 = Port 2 Error

where YY =

10 = Data loop back ok
11 = RS / CS failure
12 = No loop back hood
13 = Control line error
20 = Async, bad char looped
21 = Framing error
22 = Overrun error
23 = Parity error
24 = Baud rate too fast
25 = Baud rate too slow
26 = No char looped

ASSERTED = abcde EXPECTED = fghjk RECIEVED = mnprs

This message will be added to the PORT X DC ERROR YY when a control line is found defective.
0 = pin toggled and 1 = pin not toggled

where abcde =

a = RS-232 pin 19, signal SCA - Secondary Request to Send
b = RS-232 pin 23, signal CH - Data Signal Rate Selector
c = RS-232 pin 20, signal CD - Data Terminal Ready
d = RS-232 pin 4, signal CA - Request to Send
e = Not Used

where fghjk =

f = RS-232 pin 22, signal CE - Ring Indicator
g = RS-232 pin 12, signal SCF - Secondary Reciever Ready
h = RS-232 pin 6, signal CC - Data Set Ready
j = RS-232 pin 5, signal CB - Clear to Send
k = RS-232 pin 8, signal CF - Reciever Ready

where mnprs =

m = RS-232 pin 22, signal CE - Ring Indicator
n = RS-232 pin 12, signal SCF - Secondary Reciever Ready
p = RS-232 pin 6, signal CC - Data Set Ready
r = RS-232 pin 5, signal CB - Clear to Send
s = RS-232 pin 8, signal CF - Reciever Ready

The datacomm self-test hood loops the following pins:

19 to 12
20 to 6
23 to 22
4 to 5 & 8

Meaning

The above error codes indicate that the following modules could could be defective. They are listed in order with the highest probable failure as number one depending on which port the error was detected on.

Port 1 Errors

1. Processor PCA
2. Bent connector pins
3. Loopback hood

Port 2 Errors

1. I/O Module
2. Bent connector pins
3. Loopback hood
4. Bent connector pins the I/O module plugs into.
5. Processor PCA

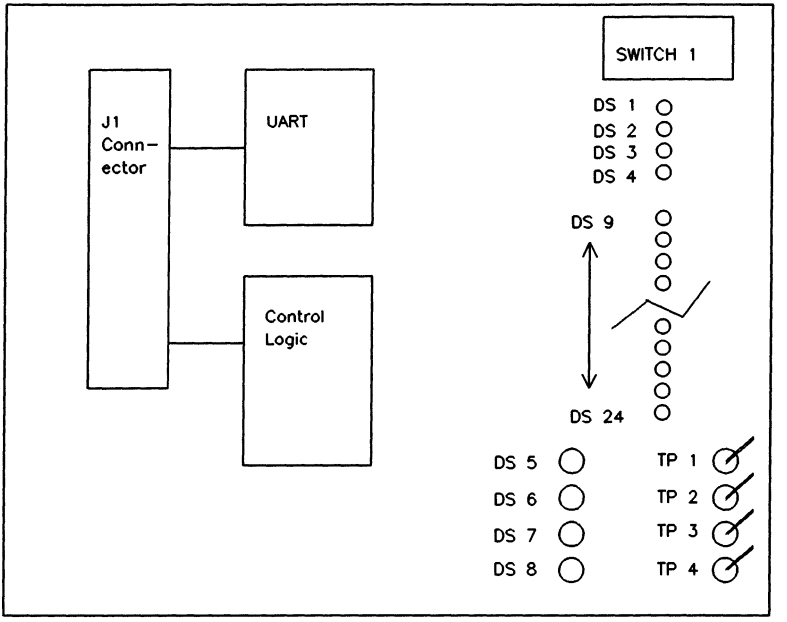

Figure 8-57 Test I/O Module

8.66 TEST MODULE LEDs

The test module contains 3 sets of LEDs. The first set of 4 LEDs are for the power supply voltages and address line activity,(DS5 to DS8). The second set of 16 LEDs, (DS9 to DS24) are not used. The third set of 4 LEDs, (DS1 to DS4) are the test status LEDs. Next comes the 3 position switch.

The power supply LEDs are positioned just behind the test points which are labeled with the respective voltages the LEDs monitor. The DS5 LED is red and when lighted represents +5 volts. The DS6 LED is yellow and represents +12 volts when it is lighted. The DS7 LED is green and when lighted represents -12 volts. The DS8 LED is red and blinks on and off to represent activity on address lines 15 and 16.

The test status LEDs indicate the status of a short test in the beginning of the OFF/ON test that indicates if the TPU processor is functional. DS 1 is the most significant bit and DS 4 is the least significant bit.

Where Test Status LEDs =

0001 = Data Bus Test
0010 = Address Bus Test
0011 = NMI Vector & Stack Test
0100 = NMI Test
0101 = Refresh Code Test
0110 = Test OK

Where Tests Points =

TP1 = +5 volts output: +4.75V - +5.25V
TP2 = +12 volts output: +10.7V - +13.8V
TP3 = -12 volts output: -10.7V - -13.8V
TP4 = Ground

Note: The keyboard or some other HP-HIL device must be connected to the TPU when making these voltage measurements (the +12volts needs a load).

Meaning

The above error codes indicate that the following modules could be defective. They are listed in order with the highest probable failure as number one.

1. Processor PCA
2. ROM PCA
3. Bent connector pins the ROM module plugs into.
4. Power Supply PCA.
5. Auxiliary I/O Module
6. Graphics Video PCA

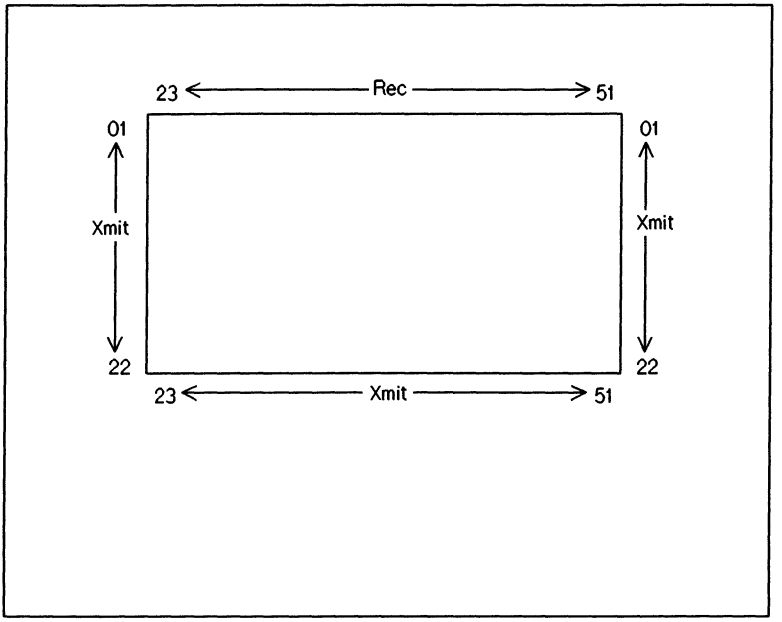

Figure 8-60 Touchscreen LEDs

8.67 TOUCHSCREEN ERROR CODES

The touchscreen is composed of 51 sets of infared LEDs. Each set is composed of a receiver and transmitter. If a finger, tape, dust or piece of paper blocks the transmission of light from a transmit LED to a reciever LED an error will result. Check for these types of errors before suspecting any hardware failures.

HP-HIL ERROR XX YYY

where XX = HP-HIL Device Address

The device address 01 is closest to the TPU. Device address increase by one as they are connected farther away from the TPU. Devices are connected in series. When the device address is 00, it indicates that the HP-HIL master controller chip is defective.

where YYY =

1-51 = Failed LED on test, channel blocked.

101-151 = Failed LED off test.

201-251 = Failed both tests.

8.70 STATUS OPERATING INSTRUCTIONS

The information for decoding status is listed in the Reference Manual. Please see the Reference Manual if status information is to be decoded.

SECTION 9

REPLACEABLE PARTS

9.00 INTRODUCTION

This section contains part lists for the 2393A and 2397A graphics terminals. The parts listed in this chapter are field replaceable. The removal and replacement procedures for these parts are found in section 6. The Illustrated Part Diagrams for the 35751M and 35751C TPUs are included in this section. These part diagrams show the location of parts that comprise a TPU.

9.10 ORDERING INFORMATION

The parts listed in this section can be ordered from Corporate Parts Center a division of Hewlett-Packard. Customers can order parts through their local Hewlett-Packard Sales and Service office.

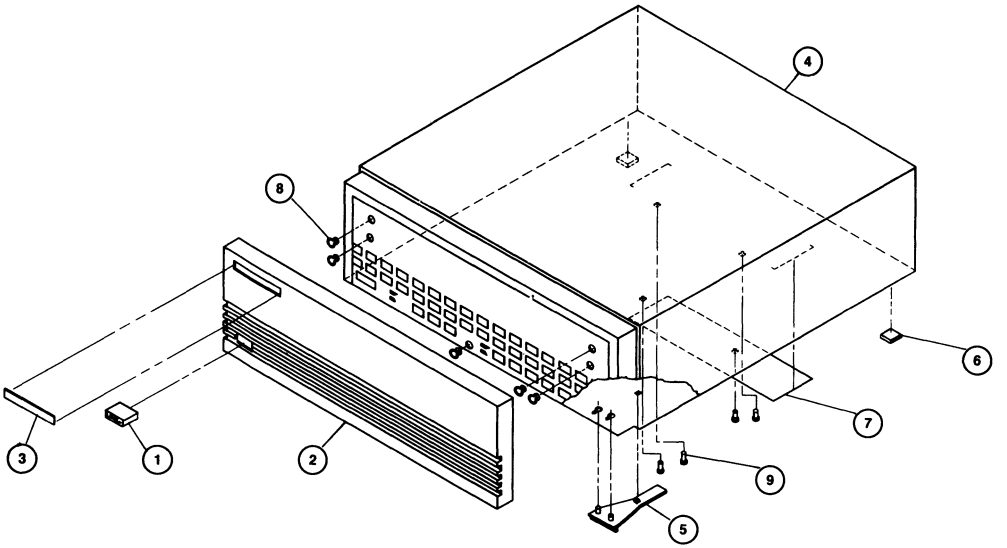

Figure 9-21 TPU Box (35751M) Part Location

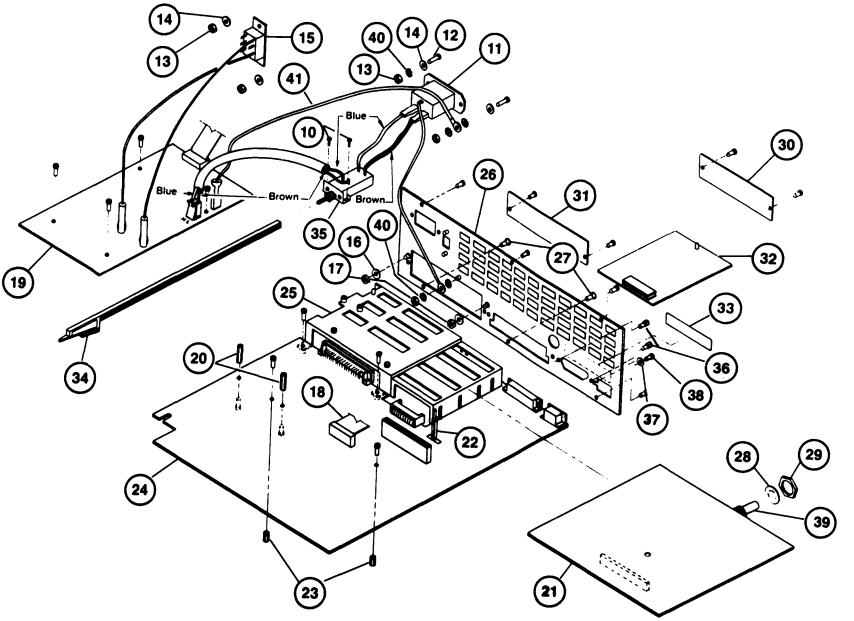

Figure 9-22 TPU Inner Module (35751M) Part Location

9.20 ILLUSTRATED PARTS BREAKDOWNS

INDEX NO.	QTY	PART NUMBER	PART DESCRIPTION
01	01	3101-0680	Power Button
02	01	35751-40001	Front Bezel
03	01	35751-90014	Label 2393A/HP Logo
04	01	35751-00001	Metal TPU Box
05	02	09121-48303	Front Foot
06	02	0403-0427	Rear Foot
07	01	35751-90013	Approval Label
08	05	0510-1270	Tubular Fasteners
09	22	0515-0211	Pan Head Screw 3x.5x6mm
10	02	0624-0452	Tapping Screw 2-28
11	01	35751-60008	Line Filter/Receptacle Assembly
12	02	0515-0054	Machine Screw 3x.5x10mm
13	04	0535-0004	Hex Nut 3mm Double Chamfer

Table 9-21 35751M Part Breakdown, Part 1

NOTE: See Figures 9-21 and 9-22 for part locations.

INDEX NO.	QTY	PART NUMBER	PART DESCRIPTION
14	04	3050-0891	Washer 3.3mm
15	01	35751-60009	Voltage Select Switch Assembly
16	02	3050-0893	Washer 4.4mm
17	03	0535-0006	Hex Nut Double Chamfer, 4mm
18	01	8120-4715	Power Ribbon Cable
19	01	0950-1740	Power Supply PCA
20	02	0380-1364	Standoff Threaded 3x20mm
21	01	35751-60004	Monochrome Graphic Video PCA
22	01	0380-1767	Plastic Standoff
23	02	0380-1361	Standoff Threaded 3x10mm
24	01	35751-60001	Processor PCA
25	01	35751-40002	Card Cage
26	01	35751-00003	Rear Panel, Monochrome TPU
27	02	0515-0076	Flat Head Screw 3x.5x4mm

Table 9-22 35751M Part Breakdown, Part 2

NOTE: See figures 9-21 and 9-22 for part locations.

INDEX NO.	QTY	PART NUMBER	PART DESCRIPTION
28	01	2190-0068	Washer for BNC Connector
29	01	2950-0154	Nut for BNC Connector
30	01	35751-00005	Cover for ROM Module
31	01	35751-00006	Cover for I/O Module
32	01	35751-60003	ROM Module PCA
33	01	35751-90011	Serial Number Label
34	01	35751-40003	Push Rod
35	01	35751-60007	On/Off Switch Assembly
36	02	1251-5352	Lock Assembly RS-232C
37	01	2260-0002	Hex Nut 4-40
38	01	2200-0774	Screw 4-40
39	01	1250-1842	BNC Connector
40	05	2190-0010	Star Washers
41	01	35751-60010	Ground Cable

Table 9-23 35751M Part Breakdown, Part 3

NOTE: See figures 9-21 and 9-22 for part locations.

INDEX NO.	QTY	PART NUMBER	PART DESCRIPTION
03	01	35751-90015	Label 2397A/HP Logo
21	01	35751-60002	Color Graphics Video PCA
22	03	0380-1767	Plastic Standoff
26	01	35751-00002	Rear Panel, Color
28	04	2190-0068	Washer for BNC Connector
29	04	2950-0154	Nut for BNC Connector
39	05	1250-1842	BNC Connector

Table 9-24 35751C Part Breakdown, Part 1

NOTE: See figures 9-21 and 9-22 for part locations. The figures are for the 35751M but it is so similar to the 35751C that a seperate figure for the 35751C was not needed. Notice the quanities for some parts change for the 35751C. Also notice that only three parts are different; HP Logo, Color Graphics Video PCA and Rear Panel.

9.30 EXCHANGE ASSEMBLIES

NEW PART NO.	EXCHANGE PART NO.	AFR	PART DESCRIPTION
35751-60001	35751-69001	4.30%	Processor PCA
35751-60002	35751-69002	3.20%	Color Graphic PCA
35731A	35731-69001	4.00%	Monitor 120v Mono
35731B	35731-69002	4.00%	Monitor 230v Mono
35741A/B	35741-69001	3.70%	Monitor Color
35723-60003	35723-69003	2.00%	Touchscreen

Table 9-31 2393A / 2397A Exchange Assemblies

9.40 FIELD REPLACEABLE PARTS

NEW PART NUMBER	PART AFR	PART DESCRIPTION
35751-60004	1.50%	Monochrome Graphic PCA
0950-1740	1.90%	Power Supply PCA
35751-60003	1.2%	ROM Module
40210-60006	1.00%	HPIB I/O Module
40210-60014	1.00%	Parallel I/O Module
40210-60015	1.00%	RS-232 I/O Module

Table 9-41 2393A / 2397A Field Replacement Modules

9.50 KEYBOARD REPLACEABLE PARTS

KEYBOARD NO.	AFR	DESCRIPTION
46020A	1.00%	United States Keyboard
46020AC	1.00%	French Canadian Keyboard
46020AD	1.00%	German Keyboard
46020AE	1.00%	European Spanish Keyboard
46020AF	1.00%	French Keyboard
46020AH	1.00%	Dutch Keyboard
46020AL	1.00%	English Canadian Keyboard
46020AM	1.00%	Latin American Spanish Keyboard
46020AN	1.00%	Norwegian Keyboard

Table 9-51 2393A / 2397A Keyboards, Part 1

KEYBOARD NO.	AFR	DESCRIPTION
46020AP	1.00%	Swiss German Keyboard
46020AQ	1.00%	Swiss French Keyboard
46020AS	1.00%	Swedish Keyboard
46020AU	1.00%	United Kingdom Keyboard
46020AW	1.00%	Dutch Azerty (Belgian) Keyboard
46020AX	1.00%	Finnish Keyboard
46020AY	1.00%	Danish Keyboard
46020AZ	1.00%	Italian Keyboard

Table 9-52 2393A / 2397A Keyboards, Part 2

PART NUMBER	DESCRIPTION
5180-6309	United States (Graphics)
5180-6310	Swedish (Graphics)
5180-6311	Norwegian (Graphics)
5180-6312	French (Graphics)
5180-6313	German (Graphics)
5180-6309	UK (Graphics)
5180-6314	Spanish (Graphics)
5180-6312	French Canadian (Graphics)
5180-6309	English Canadian (Graphics)
5180-6315	Italian (Graphics)
5180-6316	Dutch (Graphics)
5180-6317	Finnish (Graphics)
5180-6318	Danish (Graphics)
5180-6313	Swiss German (Graphics)
5180-6312	Swiss French (Graphics)
5180-6314	Latin American Spanish (Graph)
5180-6316	Flemish (Graphics)
5180-6308	United States (ANSI)

Table 9-53 2393A / 2397A Keyboard Overlays

9.60 SERVICE KIT CONTENTS

PART NUMBER	DESCRIPTION
02393-90001	User Manual
02393-90001	Reference Manual
02393-90003	Hardware Support Manual
5081-6307	Binder for User / Ref. Manuals
9282-0683	Binder for Hardware Manual
02390-60010	Test Module
5061-3248	HP-422 25 pin Test Hood
02620-60062	RS-232 25 pin Test Hood
02645-60004	RS-232 25 Holes Test Hood
5040-7433	Keycap Removal Tool
8730-0016	Tuning Tool
9300-0791	Wrist Strap and Co
9300-0794	Anti-Static Kit
40242V	Monochrome Video Cable
40242R	Color Video Cable (RGB)
46020-60001	HP-HIL Cable

Table 9-61 Service Kit Contents

NOTE: The user manual and the reference manual will change when the 2397A is introduced. The 2397A introduction will follow the 2393A introduction by three months. When the new manuals are introduced they will combine both terminals into each manual. The new part numbers for these manuals will be:

User Manual -------- 02397-90001
Reference Manual --- 02397-90002

SECTION 10

REFERENCE

10.00 INTRODUCTION

This section is for repair person collected information. The paragraph headings below list the possible information that can be included in this chapter. For example monitor information is not included in this manual. The service manuals for the monochrome and color monitors could be included in this chapter.

10.10 RELATED MANUALS

10.20 SERVICE NOTES

10.30 NEW TECHNICAL INFORMATION

10.40 SYSTEM ERROR CODES

SECTION 11

PRODUCT HISTORY

11.00 INTRODUCTION

This section is for repair person collected information.
The paragraph headings below list the possible information that can be included in this chapter. For example as part numbers change, a list of these changes can be kept in this chapter.

11.10 BACKDATING HISTORY

11.20 ROM MODULE HISTORY

SECTION 12

DIAGRAMS

12.00 INTRODUCTION

For ease of reference all pictures are included in this chapter as well as some of the charts and graphic illustrations. They provide a picture study of the 2393A and 2397A graphic terminals. Also included in this chapter is an illustrated part breakdown of the 2393A and 2397A TPU.

12.10 TEST POINTS

There are no test points located on the 2393A or 2397A graphics terminals. Test points for monitoring the power supply voltages can be found on the Test I/O Module illustrated in figure 8-57.

12.20 ENGINEERING ILLUSTRATIONS

b_8	b_7	b_6	b_5		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p					â	Å	Á	Þ
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q			À		ê	î	Ã	þ
0	0	1	0	2	STX	DC2	"	2	B	R	b	r			Â		ô	Ø	ã	
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s			È	º	û	Æ	Đ	
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t			Ê	Ç	á	å	đ	
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u			Ë	ç	é	í	Í	
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v			Î	Ñ	ó	ø	Ì	–
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w			Ï	ñ	ú	æ	Ó	¼
1	0	0	0	8	BS	CAN	(	8	H	X	h	x			´	¡	à	Ä	Ò	½
1	0	0	1	9	HT	EM	)	9	I	Y	i	y			`	¿	è	ì	Õ	±
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z			^	¤	ò	Ö	õ	º
1	0	1	1	11	VT	ESC	+	;	K	[	k	{			¨	£	ù	Ü	Š	«
1	1	0	0	12	FF	FS	,	<	L	\	l	|			~	Y	ä	É	š	■
1	1	0	1	13	CR	GS	-	=	M	]	m	}			Ù	§	ë	ï	Ú	»
1	1	1	0	14	SO	RS	.	>	N	^	n	~			Û	ƒ	ö	ß	Ÿ	±
1	1	1	1	15	SI	US	/	?	O	_	o	DEL			£	¢	ü	Ô	ÿ	

USASCII Set

Roman Extension Set

Table 12-21 ASCII Characters

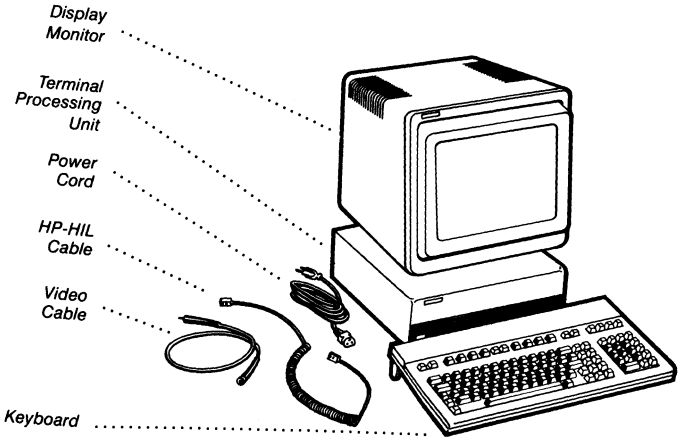

Figure 12-410 Terminal

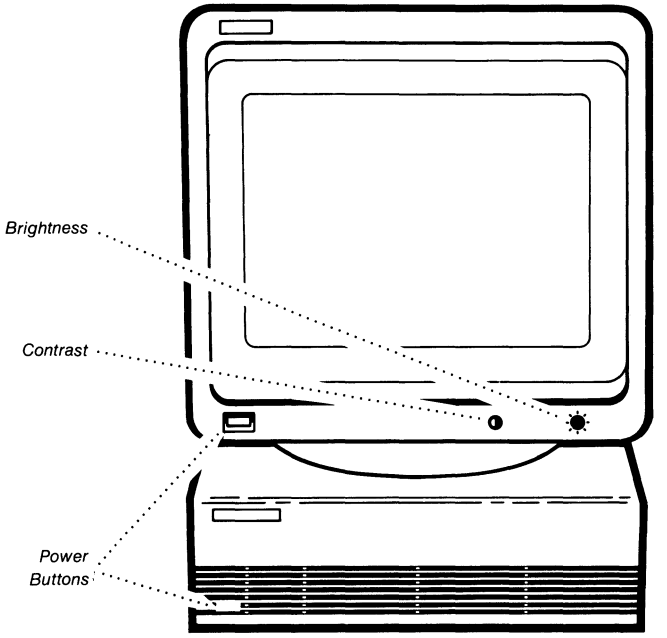

Figure 12-411 Terminal Controls

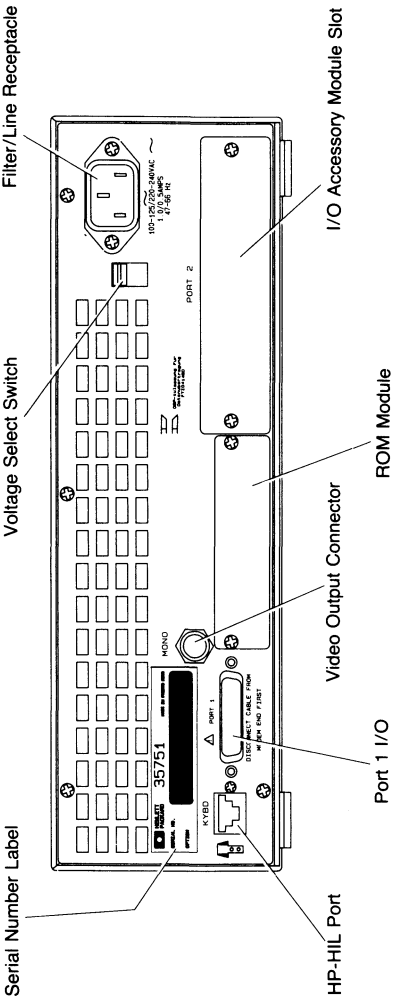

Figure 12-412 35751M Rear Panel

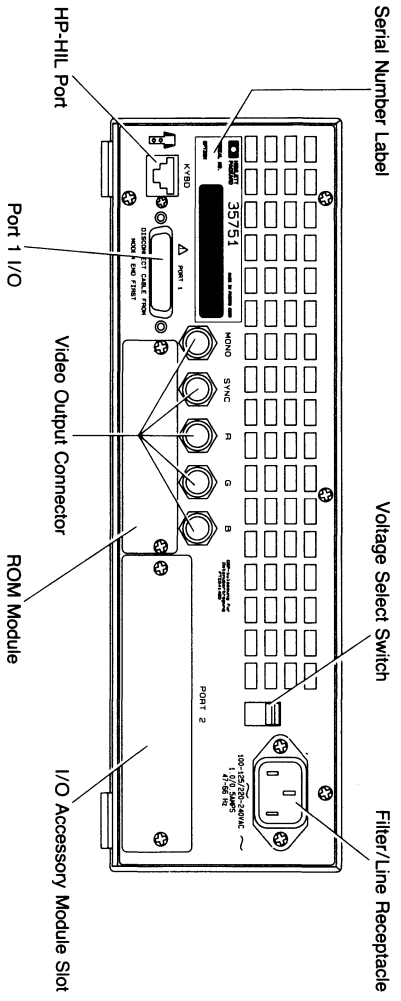

Figure 12-413 35751C Rear Panel

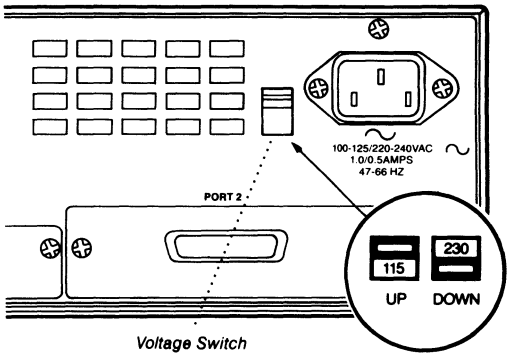

Figure 12-414 Voltage Switch (Rear of TPU)

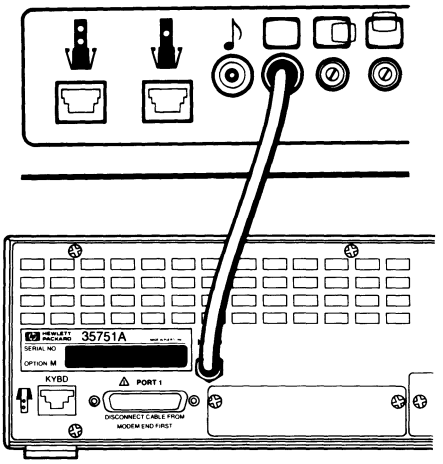

Figure 12-415 Video Connection (Monochrome)

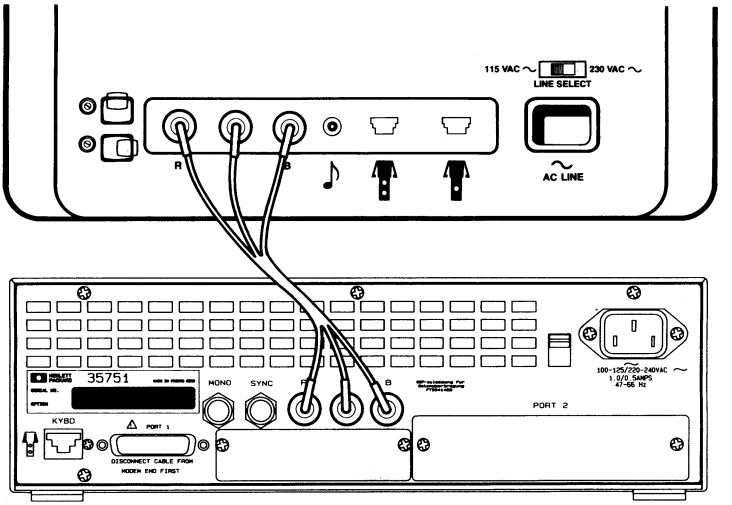

Figure 12-416 Video Connection (Color)

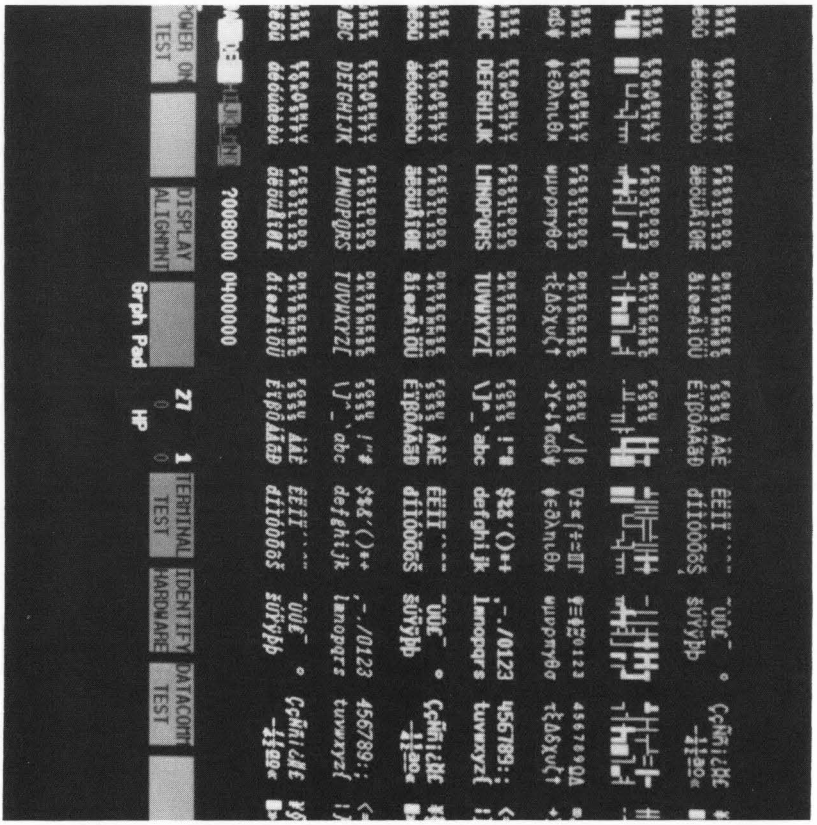

Figure 12-417 Alpha Test Pattern

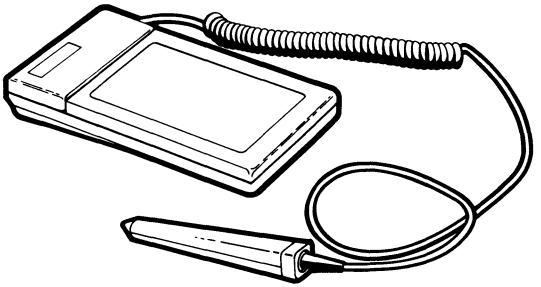

Figure 12-421 92916A Bar Code Reader

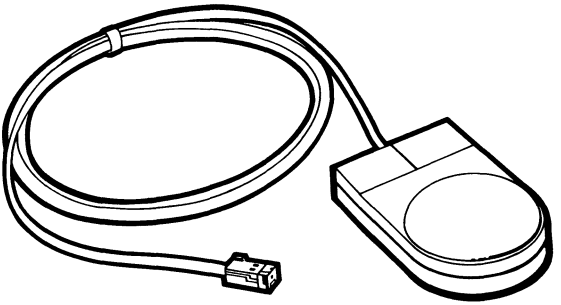

Figure 12-422 46060A Mouse

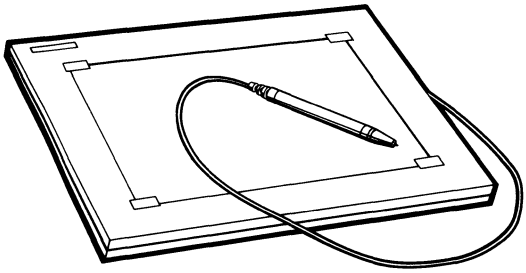

Figure 12-423 46087A A-Size Tablet

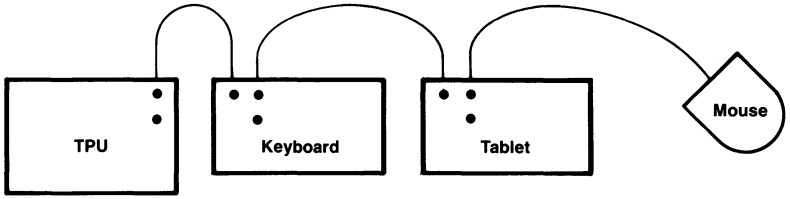

Figure 12-424 HP-HIL Loop

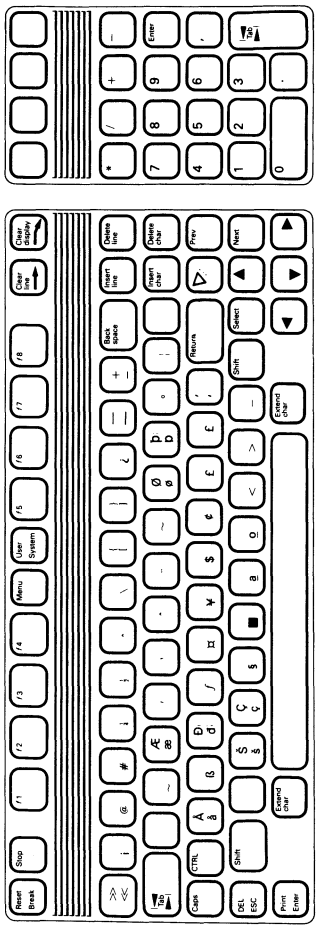

Figure 12-425 United States Keyboard

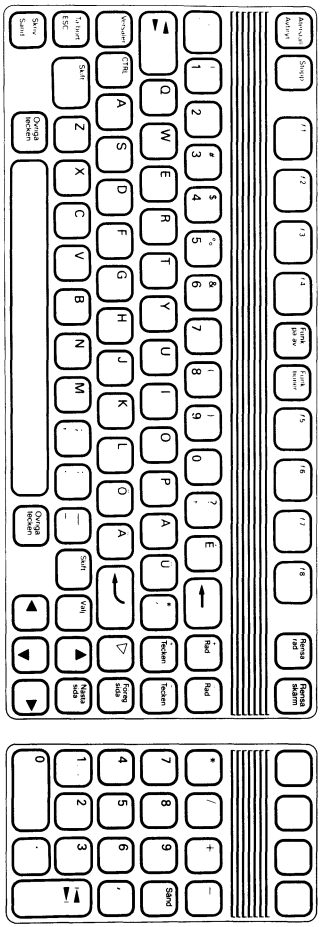

Figure 12-426 Swedish Keyboard

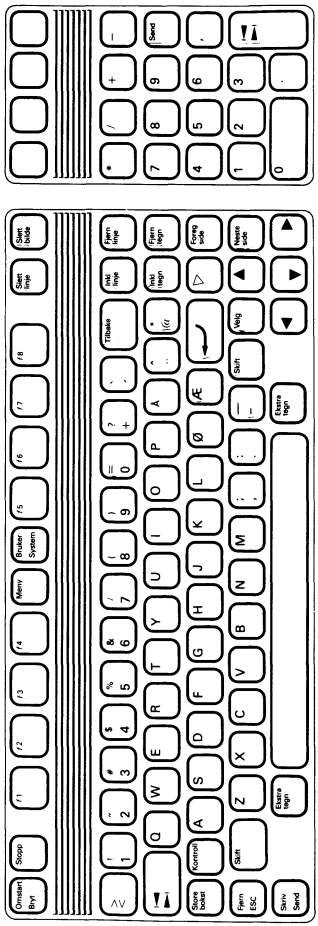

Figure 12-427 Norwegian Keyboard

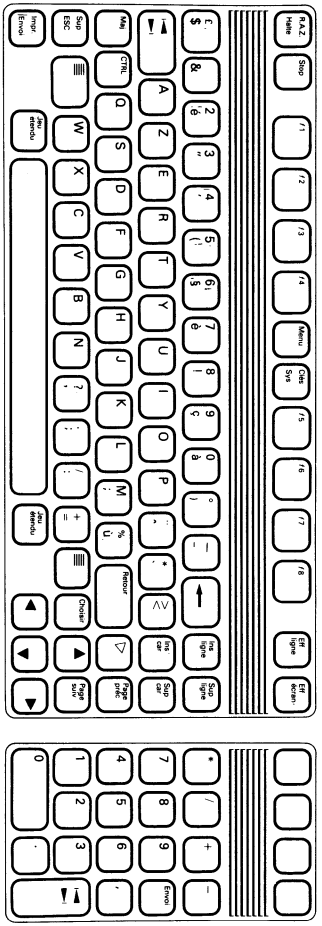

Figure 12-428 French Keyboard

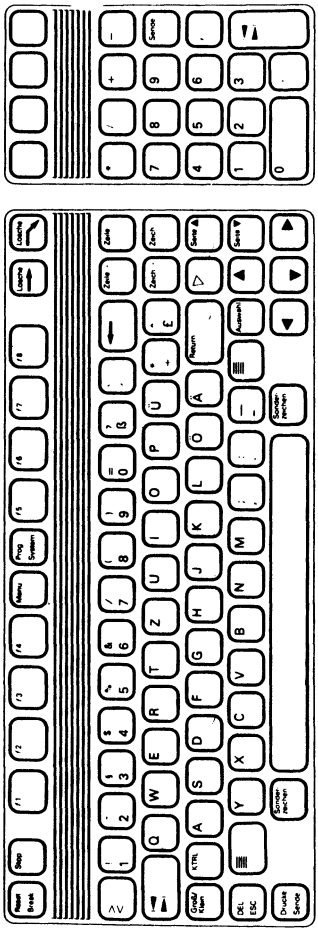

Figure 12-429 German Keyboard

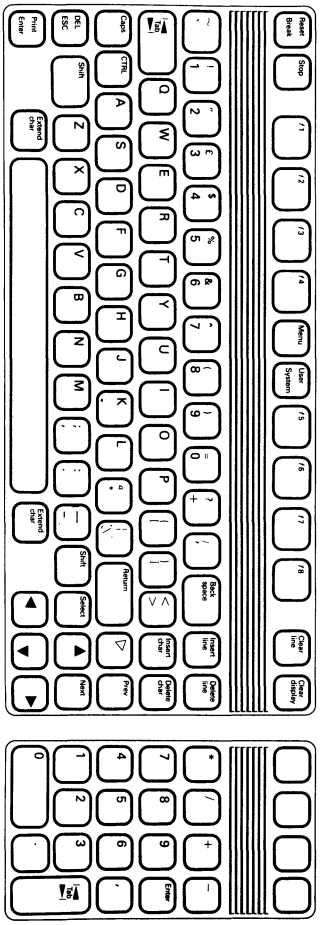

Figure 12-430 UK Keyboard

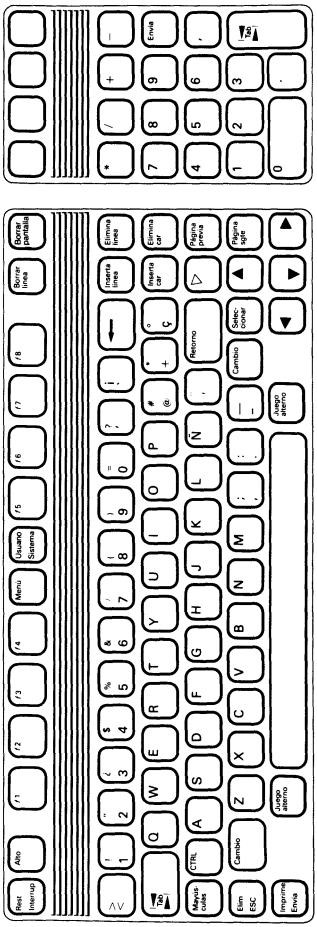

Figure 12-431 Spanish Keyboard

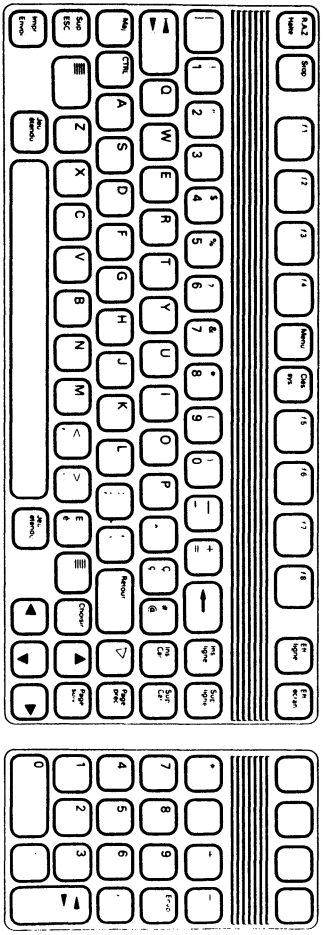

Figure 12-432 Canadian-French Keyboard

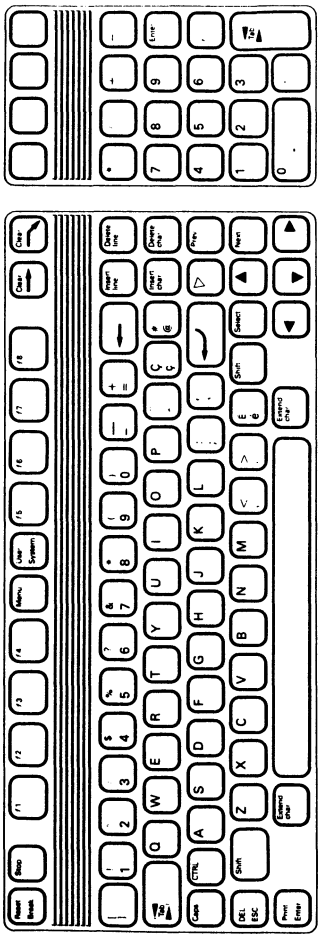

Figure 12-433 Canadian-English Keyboard

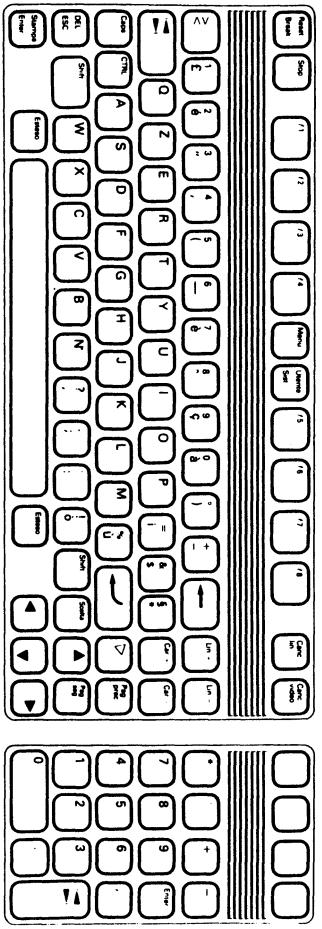

Figure 12-434 Italian Keyboard

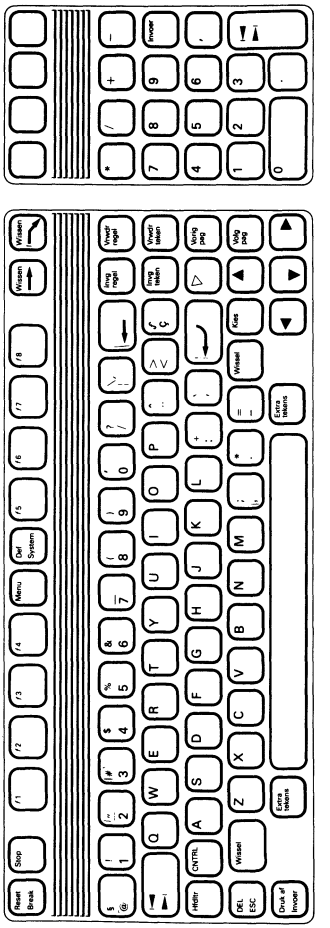

Figure 12-435 Dutch Keyboard

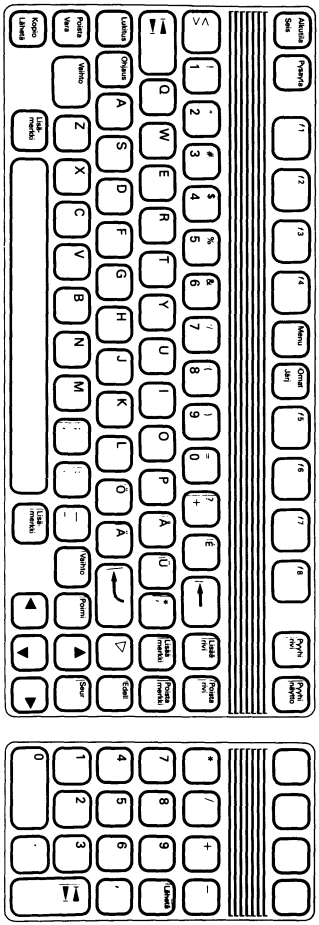

Figure 12-436 Finnish Keyboard

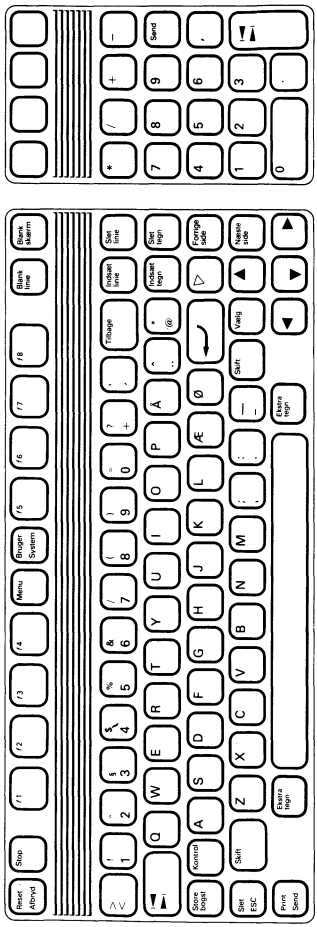

Figure 12-437 Danish Keyboard

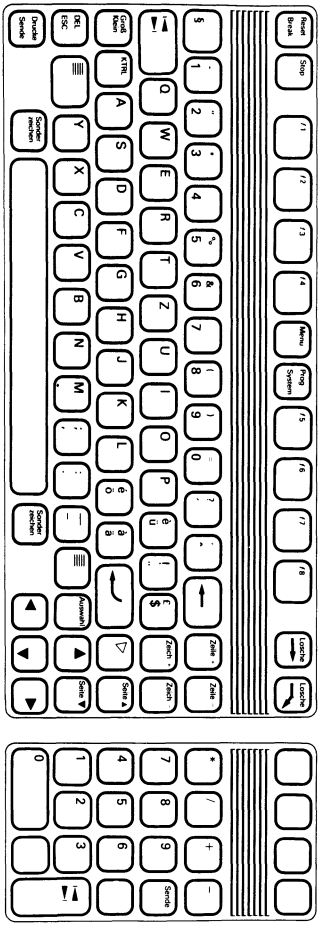

Figure 12-438 Swiss-German Keyboard

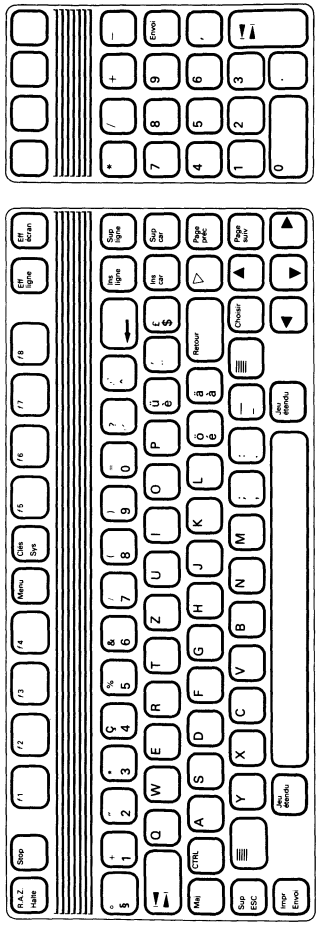

Figure 12-439 Swiss-French Keyboard

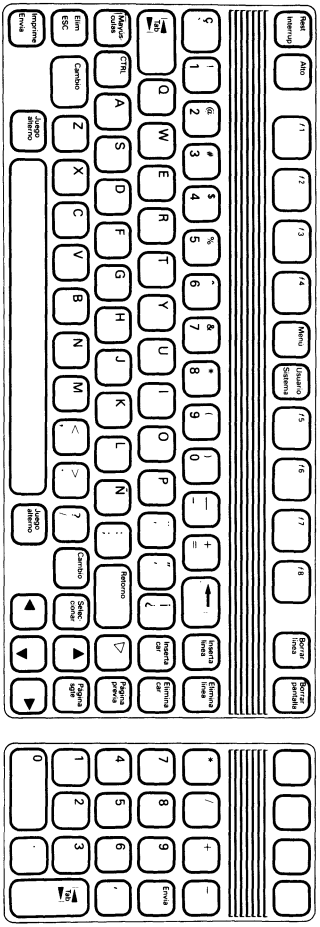

Figure 12-440 Latin American-Spanish Keyboard

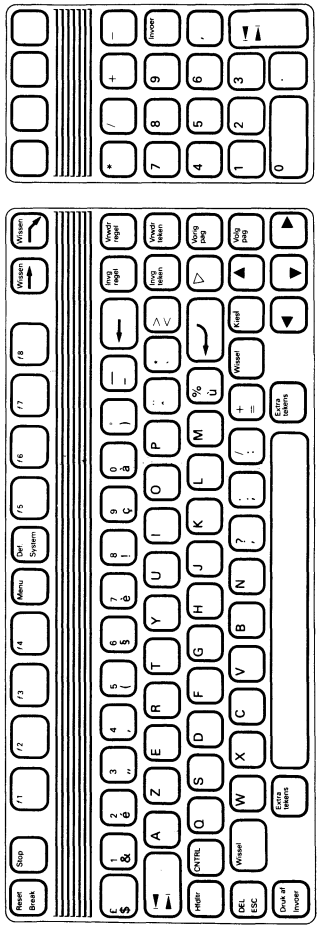

Figure 12-441 Flemish Keyboard

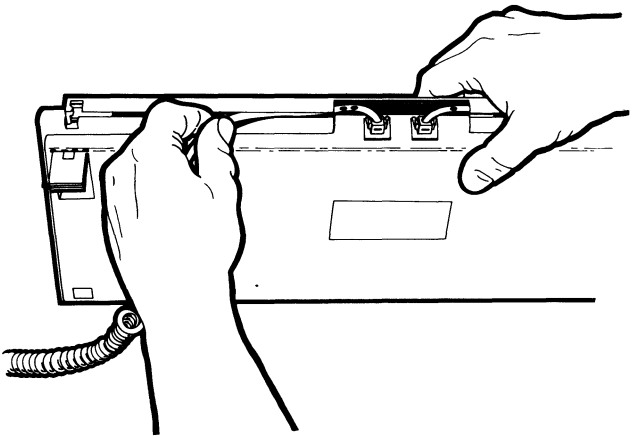

Figure 12-442 Keyboard Installation

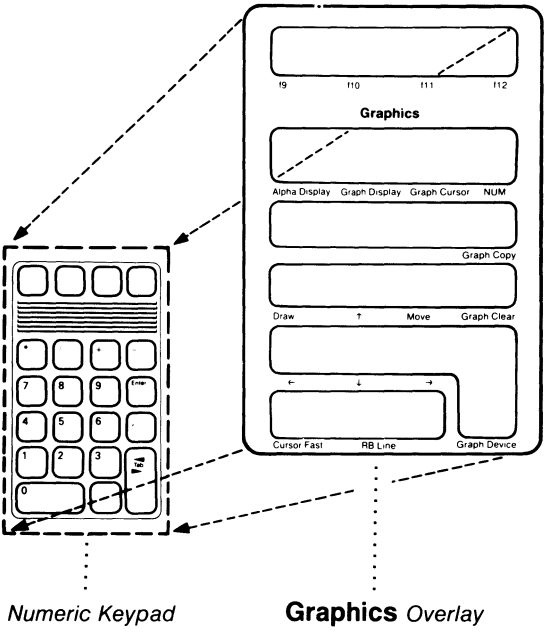

Figure 12-443 Graphic Overlay

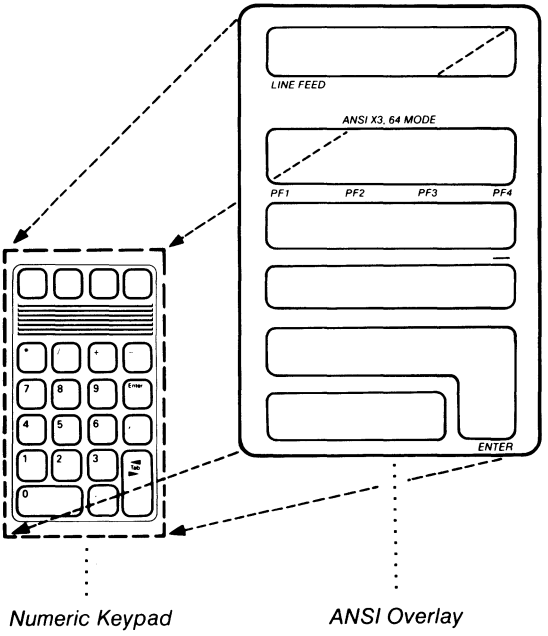

Figure 12-444 ANSI Overlay

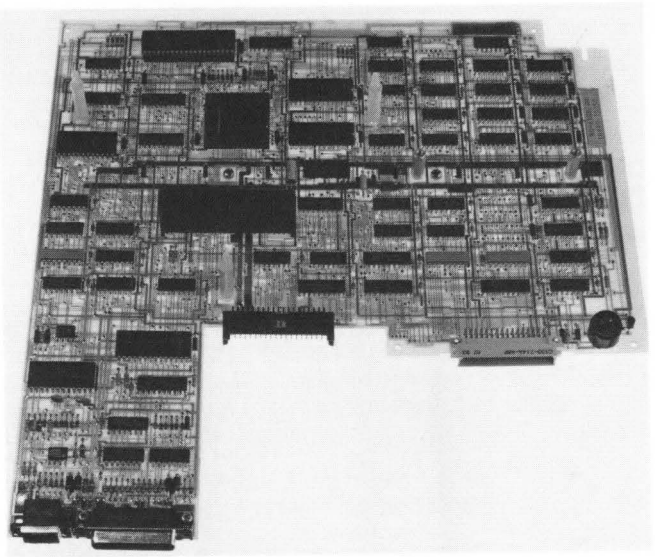

Figure 12-451 Processor PCA

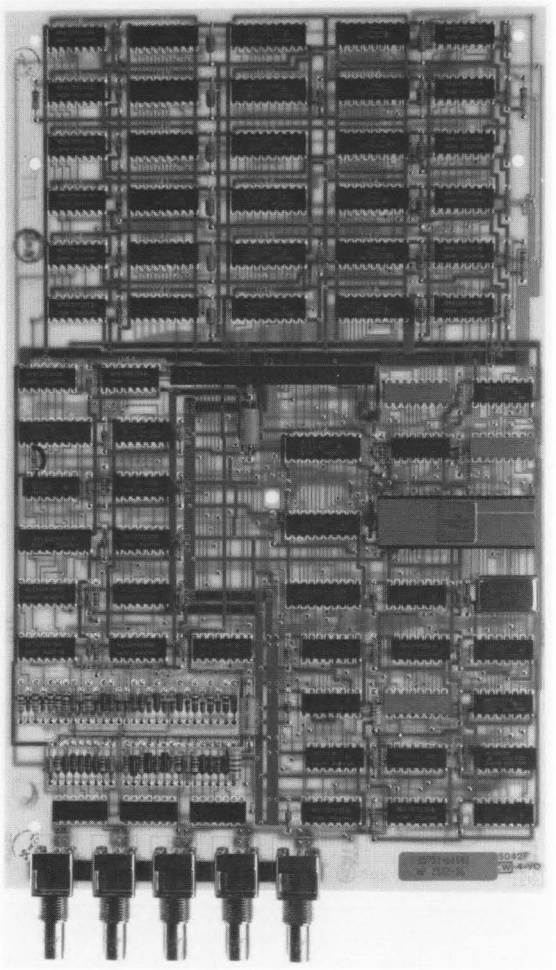

Figure 12-452 Color Graphic Video PCA

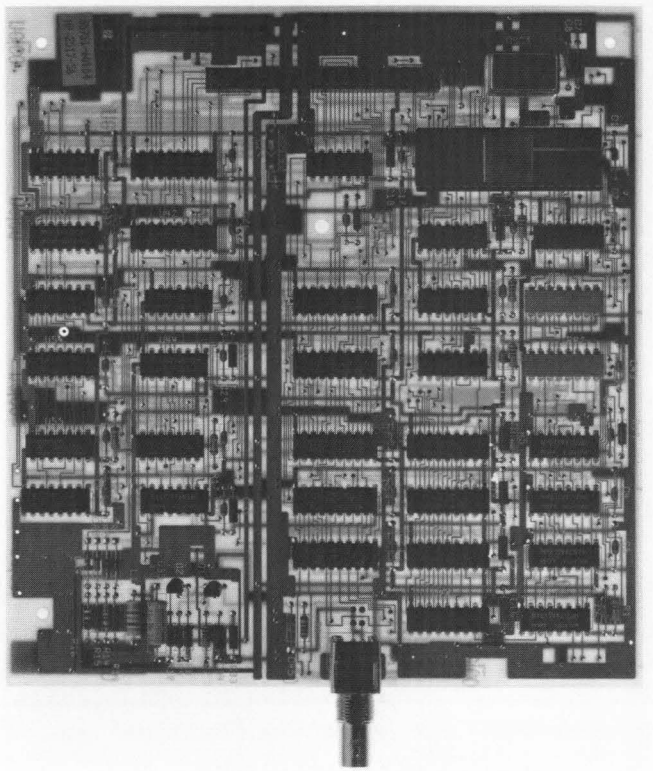

Figure 12-453 Monochrome Graphic Video PCA

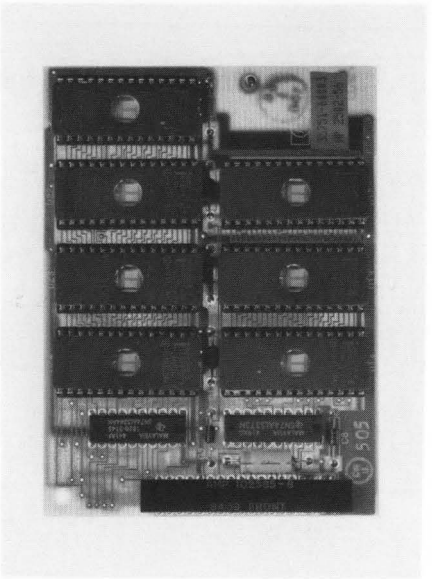

Figure 12-454 ROM PCA

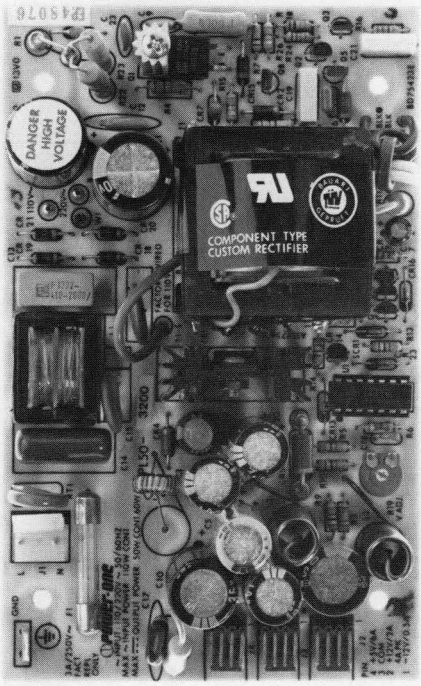

Figure 12-455 Power Supply PCA

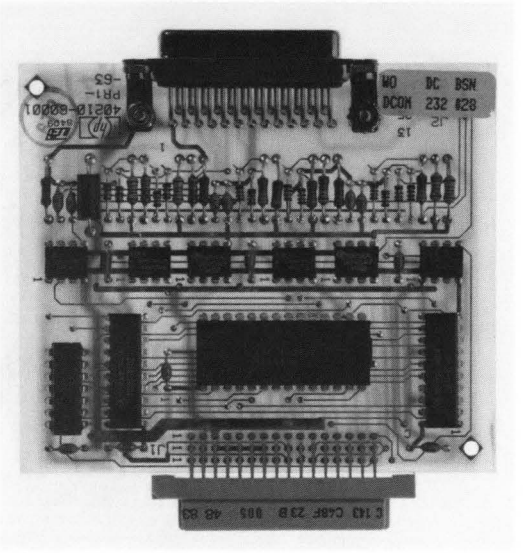

Figure 12-456 RS-232 I/O PCA

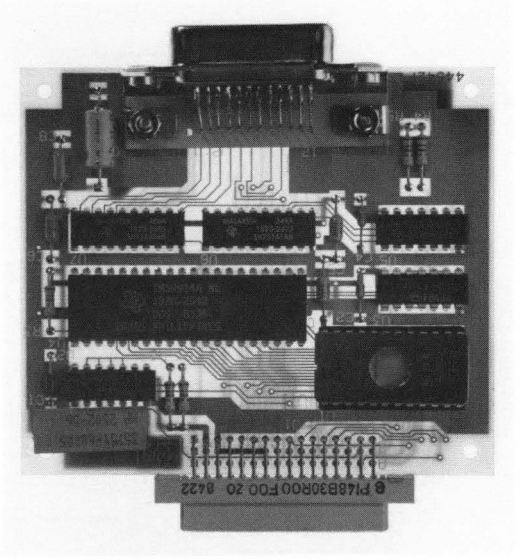

Figure 12-457 HP-IB I/O PCA

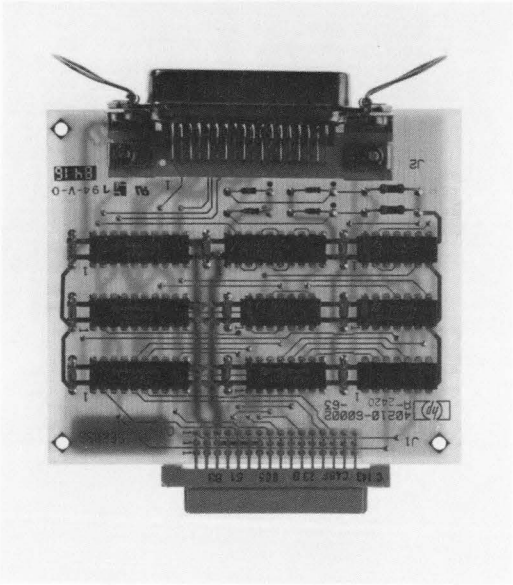

Figure 12-458 Parallel I/O PCA

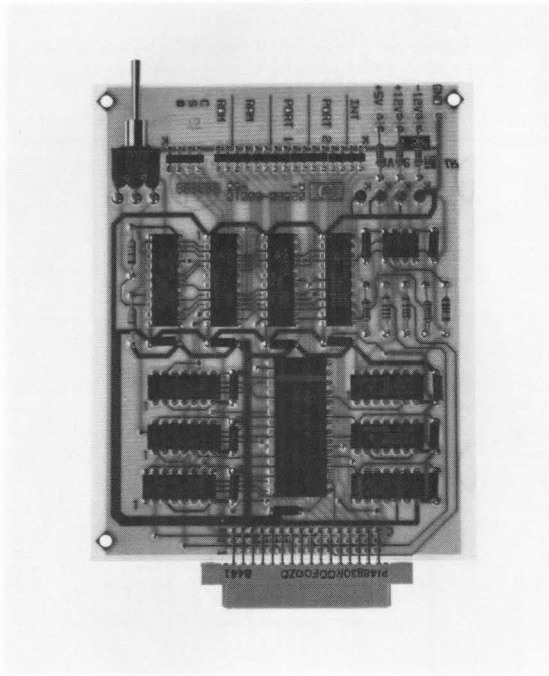

Figure 12-459 Test I/O PCA

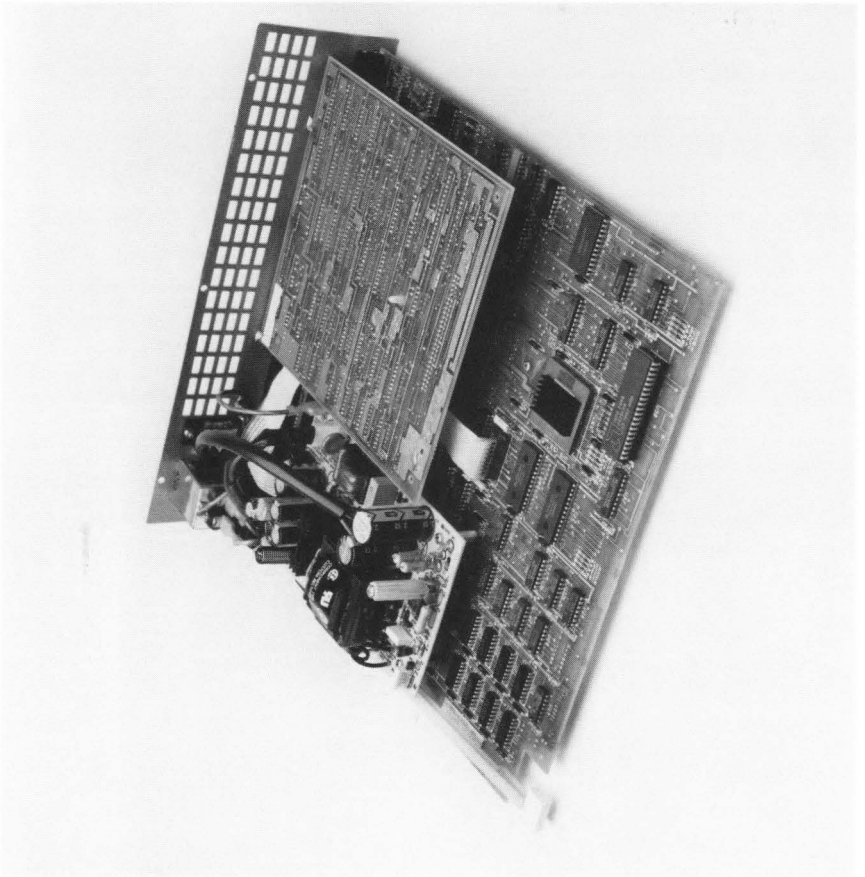

Figure 12-461 Inner Module, left side

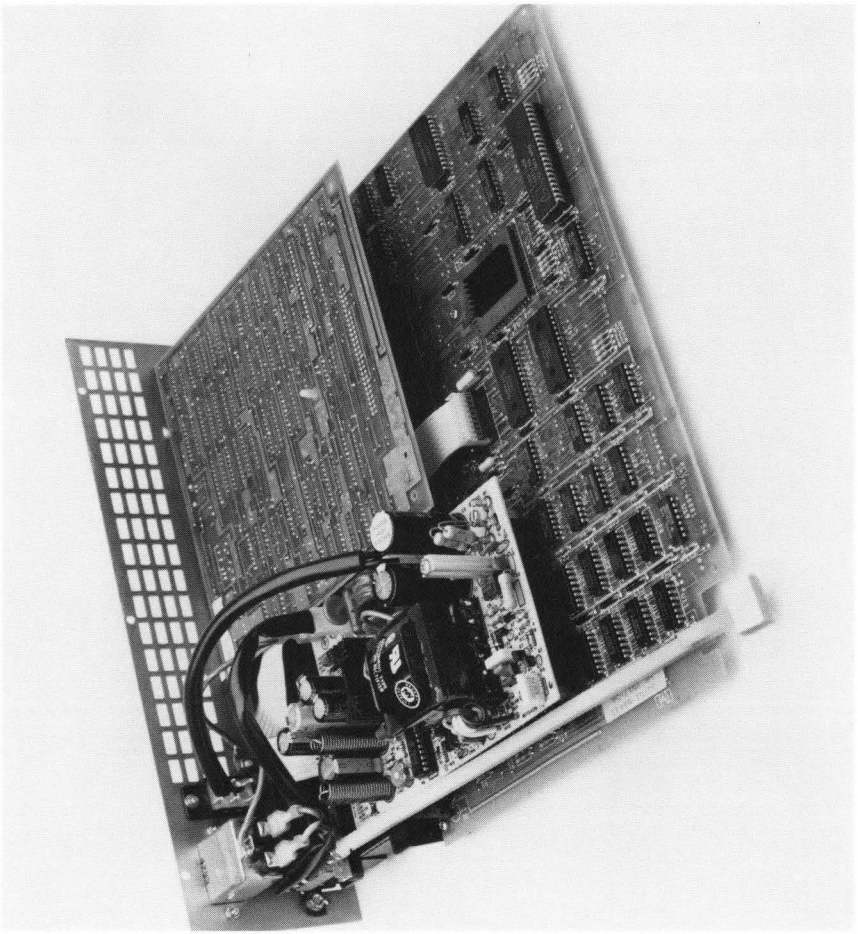

Figure 12-462 Inner Module, right side

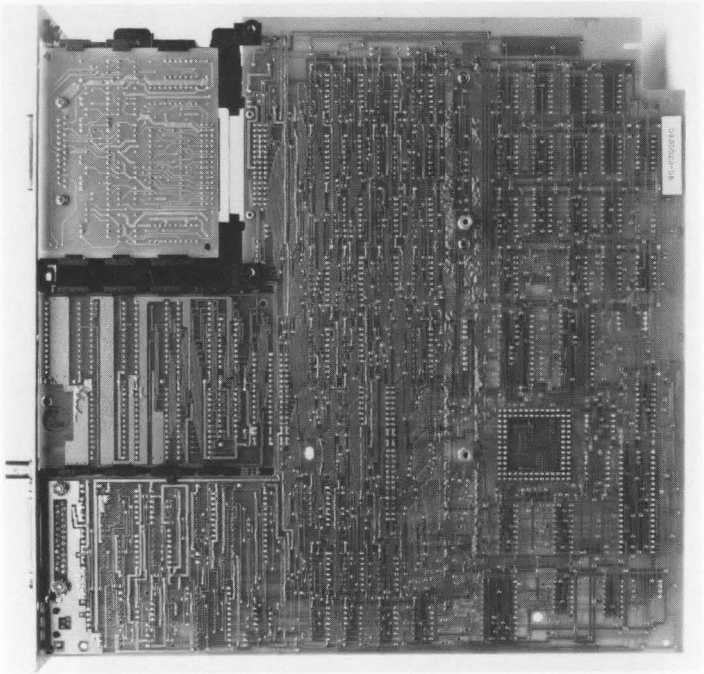

Figure 12-463 Inner Module, bottom side

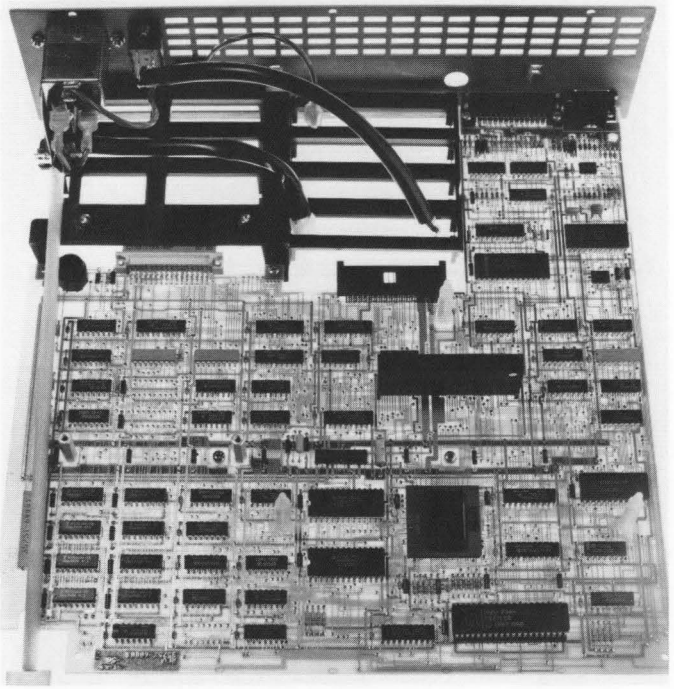

Figure 12-464 Inner Module minus Power & Graphic PCAs

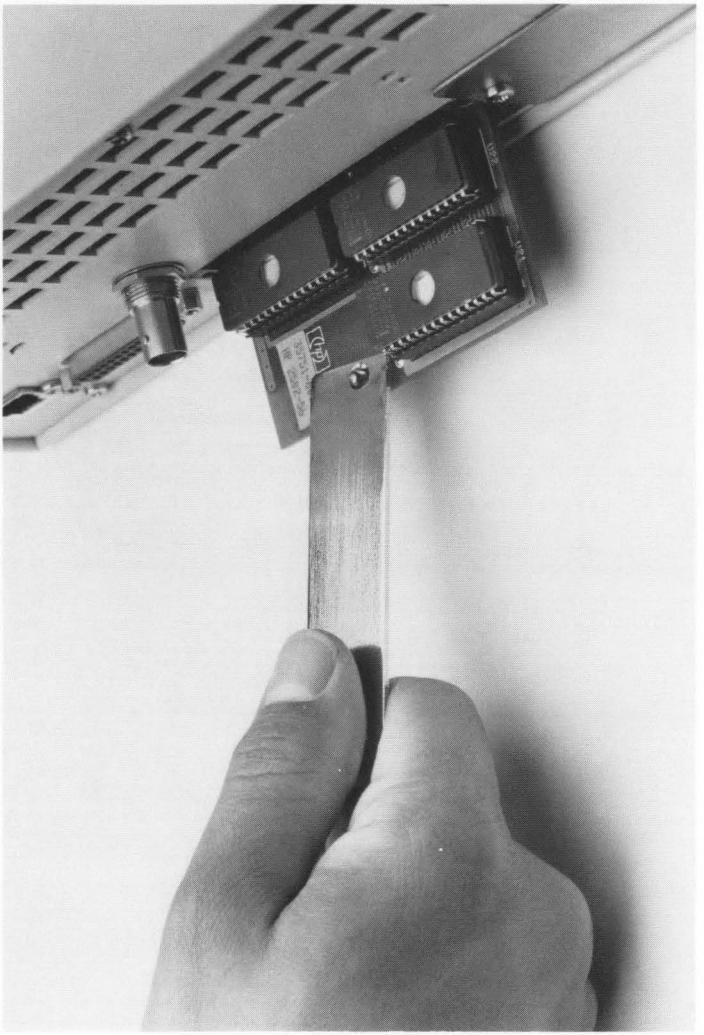

Figure 12-465 ROM PCA Removal / Replacement

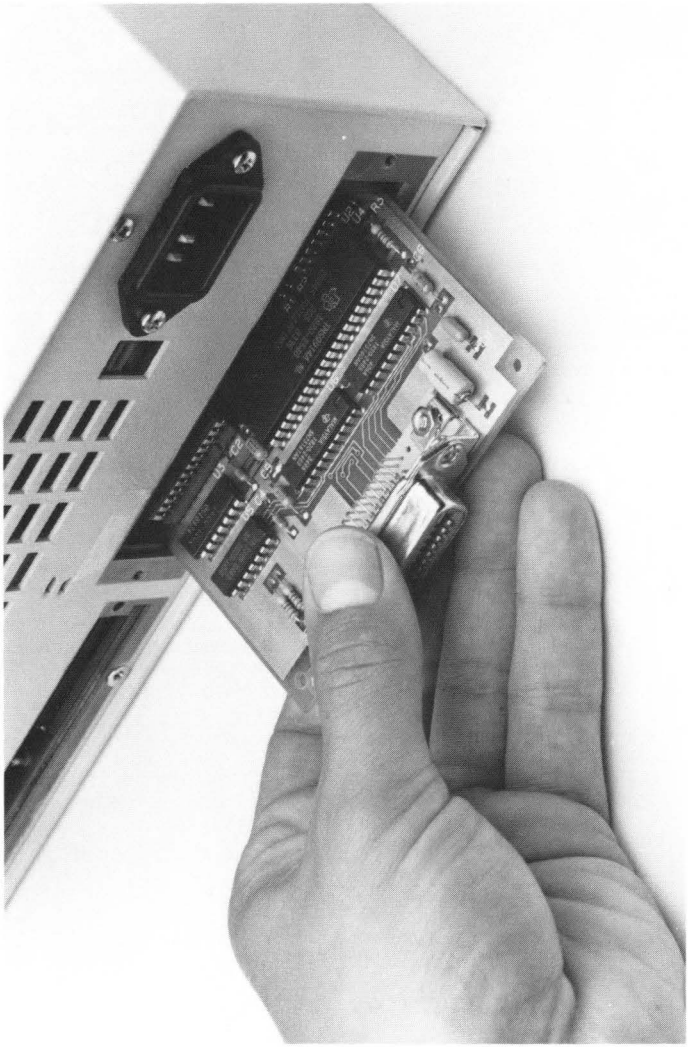

Figure 12-466 I/O PCA Removal / Replacement